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A Study of Adults with Type 1 Diabetes: Investigating Insulin Omission

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Abstract for Thesis Portfolio

Many people with diabetes find it difficult to adhere to their insulin medication regime, and may omit or restrict their insulin doses. Insulin omission has been linked to poorer health outcomes. The reasons behind insulin omission however, are not well understood.

The current research was designed to explore insulin omission in adults with type 1 diabetes. The research aims included: 1) To critically evaluate the way that adherence to insulin medication had been measured in previous studies. 2) To develop an appropriate measure of insulin omission for use in this study. 3) To investigate the relationships between insulin omission, general self-efficacy, diabetes specific self-efficacy, depression, and diabetes self-management. 4) To investigate reasons for insulin omission.

A systematic review of measures used to assess insulin adherence for people with type 1 diabetes was conducted. This demonstrated that existing measurement of insulin adherence was inconsistent, measures were not validated for type 1 diabetes, and did not allow scope for understanding reasons for insulin non-adherence or omission.

The empirical study included the development of a measure of insulin omission as well as an online survey (n=231) assessing factors associated with, and reasons for, insulin omission. Results of this study showed that insulin omission was associated with low self-efficacy, high depression scores, and poor overall diabetes self-management (all $p < .001$). The narrative information about reasons for insulin omission collected in the questionnaire generated themes on: a) Prioritising: Forgetting and the demands of daily lifestyle, b) Diabetes-related emotional distress,

c) Weight control, d) Avoidance: Fear of physical effects, and e) Adaptive responses to managing blood sugar levels.

Theoretical and clinical implications are identified and recommendations for further research are discussed.

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Introduction to the Thesis Portfolio

The thesis portfolio consists of two main papers: a systematic review and an empirical paper, on the topic of insulin adherence and insulin omission in an adult type 1 diabetes population. There is a bridging chapter which contains further information linking these two papers. Additional methodology and results chapters report further information from the empirical study. A final discussion chapter integrates the findings from the systematic review and the empirical study and discusses these in the context of current literature

The research within this portfolio focuses on type 1 diabetes. Type 1 diabetes is a chronic and complex condition characterised by high blood sugar levels (known as hyperglycemia, meaning that an excessive amount of glucose circulates in the blood plasma). This has been defined by the World Health Organisation as blood glucose levels greater than 7.0 mmol/L when fasting, and greater than 11.0 mmol/L two hours after meals. The long-term complications of persistent hyperglycemia can result in significant health conditions. Substantial lifestyle adaptations are necessary in order to manage the condition effectively, including the monitoring of physical exercise and activity, monitoring of blood sugar levels, nutritional management, and the use of insulin medication which can be taken by injection or pump.

Research suggests that many people with diabetes find it difficult to adhere closely to their recommended insulin regime, as well as to other aspects of managing their diabetes such as exercise and diet. Poorer insulin adherence has been associated with increased blood glucose levels. Given the severity of the complications associated with chronic hyperglycemia, adherence to insulin medication is critical for this population. Improving adherence is therefore a priority, however there is inconsistency in the way that insulin adherence is defined and measured.

The systematic review aims to investigate the measurement of insulin adherence in this population. The empirical study seeks to develop a measure of insulin omission and use this to investigate relationships between insulin omission, general self-efficacy, diabetes specific self-efficacy, depression, and diabetes self-management. Finally, it aims to explore and understand the reasons reported for insulin omission.

Chapter One

Systematic Review

The assessment of insulin adherence in adults with type 1 diabetes

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Word count: 5068

*This review has been written in accordance with word count and formatting
guidance for Diabetes Care (Appendix A)*

Abstract

Background

Poorer adherence to insulin medication has been linked with an increase in complications and mortality rates in people with diabetes. Improving adherence is therefore a priority, however there is inconsistency in the way that insulin adherence is defined and measured. There is currently no review investigating the measurement of insulin adherence with an exclusively type 1 diabetes population.

Purpose

This paper aims to review and critique methods used to measure medication adherence in adults with type 1 diabetes.

Data Sources

MEDLINE, Academic Search Complete, CINAHL Complete, E-Journals, PsychINFO, PsychARTICLES, and EMBASE were systematically searched.

Study Selection

Fourteen papers published between 1993 and 2016 were reviewed, all of which used and described a method for measuring adherence to insulin medication in an adult type 1 diabetes population.

Data Extraction

Information about the methods of assessment used to measure insulin adherence, and rates of adherence when reported, were extracted from each paper by the lead author.

Data Synthesis

Studies were separated into categories based on the definition and measurement of insulin adherence.

Limitations

Only articles in the English language were reviewed, and the search was limited to published studies that were available on the databases searched.

Conclusions

Insulin adherence is central to blood glucose control and disease management within type 1 diabetes, and yet there is currently no gold-standard for defining or assessing adherence. The strengths and limitations of different methods currently used are appraised, and recommendations are made for future research.

Introduction

Usually diagnosed before adolescence, and with an estimated UK prevalence in 2015 of approximately 345,000 people, type 1 diabetes is a chronic and complex condition characterised by high blood glucose levels (hyperglycemia) (1,2). The long-term complications of persistent hyperglycemia include retinopathy and blindness, nephropathy and renal failure, ischemic heart disease, stroke, neuropathy, and foot ulceration and amputation (3,4). Significant lifestyle adaptations are therefore necessary in order to manage the condition effectively, including the monitoring of blood sugar levels and of physical exercise and activity, nutritional management, and the use of insulin medication (5,6). The National Institute of Clinical and Health

Excellence guidelines (5) recommend that type 1 diabetes be treated with multiple daily insulin injections to manage blood sugar levels.

The term ‘adherence’ has been defined by the World Health Organisation (7), as “the extent to which a person’s behaviour... corresponds with agreed recommendations from a health-care professional” (p.3). This term is now preferred over ‘compliance’ which has been criticised for connoting dependence and blame towards the patient (8). For the purposes of the current paper, the term insulin omission, defined as when people with diabetes miss out insulin doses (9), and the term insulin restriction, defined as when people with diabetes take less insulin than required (10), will be included under the umbrella of ‘insulin non-adherence’, as both represent a deviation from the recommendations of a health-care professional, and are associated with worse health outcomes (10,11). These terms are discussed in more detail in Chapter 2 – Bridging Chapter. Research suggests as many as half of those with diabetes may find it difficult to adhere closely to their recommended insulin regime (9), as well as to other aspects of managing their diabetes such as exercise and diet (12), although there is limited evidence as to the reasons behind this difficulty to adhere (13). Poorer insulin adherence has been associated with increased blood glucose levels (14,15). Given the severity of the complications associated with chronic hyperglycemia (3,4), adherence to insulin medication is critical for this population.

Much of the existing research into insulin adherence in diabetes has combined the results of those with type 1 and type 2 diabetes, which is true of both empirical papers investigating insulin adherence (9,13,16), and review studies consolidating the literature about medication or insulin adherence and measurement (17,18). There

are many ways in which type 1 diabetes differs from type 2 diabetes, for example type 2 diabetes is associated with lifestyle choices, typically occurs in those over 40, and begins with impaired glucose tolerance that can initially be managed with diet and weight loss (19,20). Further, many people with type 2 diabetes are treated with oral medication (21) rather than taking insulin. A systematic review of insulin adherence demonstrated a bias within research in this area towards people with type 2 diabetes, with 58 (78%) of studies reviewed by Stolpe et al. (17) conducted exclusively with people with type 2 diabetes, compared to only 2 (3%) conducted exclusively with people with type 1 diabetes. Other systematic reviews relating to medication adherence have focused only on type 2 diabetes (22,23). This has meant that any conclusions about medication and insulin adherence in diabetes and its measurement have been based predominantly on studies investigating type 2 diabetes (17,18,22,23).

Existing reviews summarising the literature on medication adherence in diabetes have reported a lack of consistency in the way adherence is both defined and measured (17,18,22,23). Clifford et al. (18) reviewed the measurement of medication adherence (which combined adherence to insulin and adherence to oral medication taken by those with type 2 diabetes) in adults and children with type 1 and type 2 diabetes between 2007 and 2013, and described an extensive range of measures used. The measures reported included patient or observer assessment, pill counts, medication monitoring systems, mobile phone calls, logbooks, and pharmacy claims databases. Stolpe et al. (17) reviewed measures of insulin adherence in adults with type 1 and type 2 diabetes between 2000 and 2015, and reported less variation in methodology compared to Clifford et al. (18). Stolpe et al. (17) reported that the top

five most commonly used methodologies all used insulin prescription data from pharmacy records, with the sixth most common being a self-report questionnaire. The inconsistency in findings between these reviews indicates that further investigation is required. Further, in order to direct those with type 1 diabetes to appropriate resources, it is important to ascertain data about insulin adherence and the measurement of insulin adherence in people with type 1 diabetes.

This paper aims to review and critique existing methodologies for measuring insulin adherence in adults with type 1 diabetes. It is expected that, as found in mixed population reviews, there will be a lack of consistency in the measurement of insulin adherence between different studies.

Method

Data Sources and Searches

A systematic literature search using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (24) was conducted in order to identify published articles that described a method of measuring medication adherence in adults with type 1 diabetes. A number of databases were systematically searched for relevant articles, including PsycINFO, PsycARTICLES, MEDLINE, CINAHL Complete, E-Journals, Academic Search Complete, and EMBASE, on 12th December 2016. No historical start date was imposed in order to include any studies that may have been missed by previous reviews (17,18). The key words used to identify studies included ‘type 1 diabetes’ or ‘t1d’ or ‘diabetes mellitus type 1’ or ‘juvenile diabetes’, as well as ‘adherence’ or ‘compliance’ or ‘nonadherence’ or

‘noncompliance’ or ‘omission’, as well as ‘insulin’ or ‘medication’. The search eliminated papers with the terms ‘type 2 diabetes’ or ‘type 2 diabetes mellitus’ or ‘t2dm’, and ‘paediatrics’ or ‘children’ or ‘child’ or ‘adolescents’ or ‘adolescence’. The search was limited to articles published in the English language.

Eligibility Criteria

Eligibility criteria for inclusion in the review consisted of: an adult (18 years plus), with a diagnosis of type 1 diabetes, as defined by the study, and a quantifiable method to measure adherence to insulin medication described by the paper. Papers returned from this search that had mixed populations (child and adult, or mixed diabetes) but provided separate analyses for these groups and/or adjusted the measures used were included, and all designs were considered providing a form of measurement was described. Exclusion criteria included studies of a type 2 diabetes population, or studies reporting results for only mixed diabetes populations, or paediatric populations, or those reporting only mixed populations. Studies reporting adherence measures of mixed treatments or behaviours e.g. diabetes self-care generally, without specifically reporting insulin adherence, were excluded, as was qualitative research which did not include a quantifiable measurement of adherence.

Study Selection

The initial search returned a total of 612 articles, which were screened for inclusion. Stage 1 screening included screening the title and abstract for relevance to the research question and against the specified inclusion and exclusion criteria. If

articles passed this level of screening, or were ambiguous (e.g. if they did not specify the age range or diabetes type in the abstract), they were screened using the full text (Stage 2 screening). Finally, papers which were not eliminated at this stage were eligible for data extraction. The main reasons for exclusion of papers at all stages were that they either included both type 1 and type 2 diabetes or defined diabetes as 'diabetes mellitus', or 'insulin dependent'. Other common reasons for exclusion were that a method of measuring insulin adherence was not described, or that insulin adherence was not measured independently of other aspects of diabetes care. Figure 1 depicts this process. Fourteen articles met all study criteria and were included in the review.

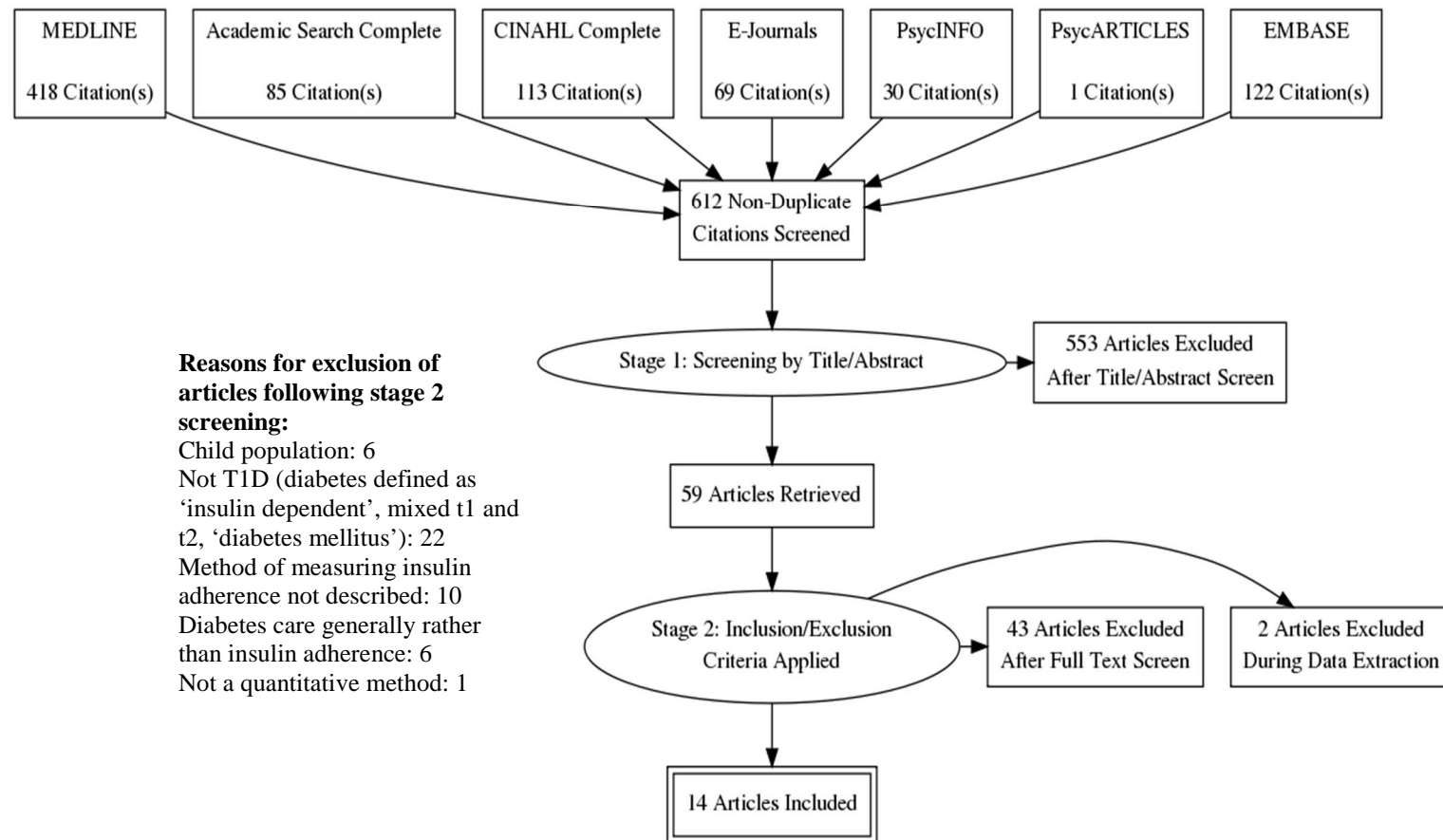


Figure 1 – PRISMA diagram depicting article selection process.

Data Extraction and Quality Assessment

Data were extracted by the first author (SA). Information extracted from the articles included sample size, method of assessing insulin adherence, and any quantitative information about rates of adherence to medication reported by the paper. A quality assessment of the selected papers was conducted based on the Understanding Health Research tool (25), a method for reviewing the quality of health research tested with both patients and medical professionals. Only sections relevant to the methodology were applied due to the methodological focus of the current paper. The clarity of the description of the method for assessing insulin adherence was rated separately in order to determine whether the methodology could be replicated based on the information given. Ratings of this were from 1 (limited description) to 3 (clearly described), see supplementary tables 1 and 2 for full details.

Data Synthesis and Analysis

The outcome of interest was the method used to assess insulin adherence. Methods are described together based on similarities in how they defined adherence, and are described qualitatively due to the focus on methodology and the heterogeneous nature of the studies (26).

Results

Fourteen studies were included in the systematic review, totaling 12,120 participants. Of these, ten measured insulin adherence using patient self-report (including

interview and questionnaire methods), three used medical databases which were based on clinical notes, and one used medical monitoring. Adherence rates reported ranged from 10% (27) to 99% (28), although the variety in methods made it difficult to usefully compare adherence levels across studies. Eleven of the studies were carried out in developed countries, and three (27, 28 & 44), were carried out in developing countries. Table 1 lists the included articles and their adherence measures, as well as the study design, sample size, rates of adherence reported, and quality rating.

Supplementary Table 1. Quality assessment rating scale

<i>Category</i>	Ethical procedures mentioned?	Clear research questions or aims?	Information about participant characteristics?	Paper explains how sample is representative of the wider population?	Sample size justified?	Response rate / withdrawal rate reported?	Setting of data collection described?	Method of measuring insulin adherence clearly described?	Overall rating
<i>Description for rating</i>	Reference to study approval boards or bodies, and/or processes such as informed consent	Paper states what it is trying to achieve.	Such as gender, age, length of illness, type of medication, co-morbidities, etc. At least 2.	Statement about how sample might be generalizable (or not) to wider population.	Sample size discussed with reference to study design and/or statistical tests used.	Is number of participants who dropped out or became ineligible though the course of the study reported? Not applicable for studies which were one off.	i.e. using databases, at clinics, in patients' homes, online, etc.	0= no description 1=very brief description 2=described but with some aspects of measurement e.g. exact wording missing 3=clearly described	8-10 Excellent 6-7 Very good 4-5 Reasonable 1-3 Limited

Supplementary Table 2. Quality rating of included papers

Authors date and reference	Ethical procedures mentioned?	Clear research questions or aims?	Information about participant characteristics?	Paper explains how sample is representative of the wider population?	Sample size justified?	Response rate / withdrawal rate reported?	Setting of data collection described?	Method of measuring insulin adherence clearly described?	Overall rating (sum of individual ratings)
Farsaei et al. (2014) (28)	1	1	1	1	0	0	1	3	8 = Excellent
Trief et al., (2014) (31)	1	1	1	1	1	0	1	3	10 = Excellent
Gomes, & Negrato, (2016) (27)	1	1	1	1	1	0	1	3	9 = Excellent
Merwin et al., (2014) (38)	1	1	1	0	1	0	1	3	8 = Excellent
Markowitz, Carper, Gonzalez, Delahanty, & Safren, (2012) (39)	1	1	1	1	1	1	0	2	8 = Excellent
Louch, Dalkin, Bodansky, & Conner, (2013) (33)	1	1	1	1	0	1	1	2	8 = Excellent

Merwin et al (2015). (34)	1	1	1	1	0	1	1	3	9 = Excellent
Gurkova, & Ziakova, (2014). (35)	0	1	1	0	0	1	1	2	6 = Very good
Peveler, Davies, Mayou, Fairburn, & Mann, (1993). (36)	1	1	1	1	0	1	1	2	8 = Excellent
Takii et al (2008)	0	1	1	0	0	0	1	2	5 = Reasonable
Currie et al (2013) (41)	0	1	1	1	0	0	1	1	5 = Reasonable
Thompson, Cummings & Chalmers (1995) (42)	0	1	1	0	0	-	1	1	4 = Reasonable
Smith et al (1999)	1	1	1	0	0	-	1	1	5 = Reasonable
Vimalavathini, Agarwal, & Gitanjali, (2008). (44)	1	1	1	1	0	0	1	3	8 = Excellent

Table 1. Summary table of the assessment of insulin adherence used in articles reviewed

Authors and date	N	Type of study	Method(s) used	Description	How insulin adherence was defined	Adherence to insulin rate (if reported)	Clinical indicator	Quality Rating (Overall score for methodology, and rating for clarity of description of measurement)
Farsaei et al. (2014) (28)	507	Cross-sectional telephone study	Self-report questionnaire administered by telephone	Adherence to insulin was measured using the 8 item Morisky Medication Adherence Scale (MMAS), and also using the auto-compliance method, where patients were asked "How many times did you skip an insulin injection in the last month?". This was divided by the total number of prescribed injections and multiplied by 100 to give a total score.	On the MMAS a patient was considered low adherent if they received scores of less than 6. Using the auto-compliance method, patients who reported taking more than 80% of their prescribed insulin dose were considered to be adherent to insulin.	Using the MMAS, 22% had high adherence, 63% had medium adherence and 14% had low adherence. Using the auto-compliance method 99% were adherent.	None	Overall: Excellent. Clearly described.
Trief et al. (2014) (31)	6172	Cross-sectional online questionnaire study also using medical chart review. Group comparison study.	Self-report questionnaire administered online.	Participants were asked 'How often do you miss an insulin dose?' Other areas relevant to insulin adherence were also reported including 'demonstrated accurate withdrawal of insulin dose' 'proper storage of insulin vials in home' and 'buy insulin from chemist if insulin is insufficient'.	Four categories of adherence to insulin doses were reported for analyses: missing doses almost never, less than once a week, 1-2 times a week, and ≥ 3 times a week.	In the depressed group, 25% missed insulin doses ≥ 3 times a week, and 43% missed doses almost never. In non-depressed group, 9% missed insulin doses ≥ 3 and 54% missed doses almost never.	HbA1c	Overall: Excellent. Clearly described.

Gomes, & Negrato, (2016). (27)	1698	Cross-sectional clinic based questionnaire study.	Self-report questionnaire administered during clinic visit.	Adherence to insulin was based on self-reported scales that measured medication-taking behavior in the last month, using questions adapted from the 4-item Moriksy Medication Adherence scale (11).	Patients were considered high adherent if they answered no to all 4 questions. They were considered to have moderate adherence if they answered yes to one or two question. Patients were rated as having a low level of adherence if they answered yes to three or four questions.	10% of patients reported maximal adherence, 42% reported moderate adherence, and 48% of the patients reported minimal adherence to insulin.	HbA1c	Overall: Excellent. Clearly described.
Merwin et al., (2014) (38)	276	Cross sectional online questionnaire study. Eating disorder focus but general population sample.	Self-report questionnaire administered online.	Three items that covered insulin management were used from the DEPS-R, Markowitz et al., (2010), which is a self-report measure assessing eating disorder behavior and attitudes over the past four weeks.	Scores were combined to make a 'weight related insulin mismanagement' continuous variable for use in analysis.	Adherence rate specifically to insulin not reported.	HbA1c	Overall: Excellent. Clearly described.

Markowitz, Carper, Gonzalez, Delahanty, & Safren, (2012). (39)	9	Pilot intervention study of cognitive behavioural therapy for adherence and depression.	Self-report questionnaire administered during interview with clinician.	Participants were instructed to report how often they took their insulin on a 10-point scale from 0% to 100% of the time in the past 2 weeks. This questionnaire was adapted from a questionnaire used by Lu et al to assess adherence to antiretroviral medications.	Higher scores were taken as increased adherence, and scores were used for pre and post comparisons.	Baseline and post intervention self-reported insulin doses were 77% and 87% respectively.	HbA1c	Overall: Excellent. Some aspects of measurement missing.
Louch, Dalkin, Bodansky, & Conner, (2013). (33)	18	Randomised controlled trial of text messaging intervention.	Self-report question about frequency of injections.	Participants self-reported how many insulin injections they self-administered in the morning, afternoon and evening of the previous week.	Increased injections were taken as increased adherence.	Only mean differences pre and post intervention reported, not rates.	None	Overall: Excellent. Some aspects of measurement missing.
Merwin et al (2015). (34)	83	Ecological momentary assessment – telephone questionnaire study. Eating disorder focus and sample.	Self-report repeated single question administered by automated telephone programme.	Participants were asked over the phone after eating, “Did you take enough insulin to cover your food?” They could press keys indicating “yes,” “maybe,” or “no.” Participants were instructed to respond “no” if they intentionally took less insulin than was needed (under dosed) or completely omitted a necessary insulin dose.	Insulin restriction at each eating occasion was defined as responding “no” to the question: “Did you take enough insulin to cover your food?”	Participants reported restricting insulin for 22% of the eating episodes recorded.	HbA1c	Overall: Excellent. Clearly described.

Takii, et al., (2008) (11)	109	Interview study with eating disorder focus and sample.	Self-report clinical interview and clinician report medical records.	Patient interview done in a counselling session. Information crosschecked using patient history and the HbA1c course reported by the referring physician.	Insulin omission was defined as omission/reduction of at least one-quarter of the prescribed insulin when done mainly for preventing weight gain.	68% of type 1 diabetic females with clinical eating disorders presented with severe insulin omission.	HbA1c	Overall: Reasonable. Some aspects of measurement missing.
Gurkova, & Ziakova, (2014) (35)	62	Cross-sectional structured interview with questionnaires	Structured interview and questionnaire	Patient interview used to collect information about self-adaptation of insulin dosage. Information was also collected during clinic visits.	Not labelled as adherence, but whether insulin was adapted in relation to other factors such as carbohydrate intake, glycaemia values or degree of physical activity was measured.	48/62 reported self-adaptation of insulin dose in response to results of self-monitoring of glucose levels, sick days, exercise, carbohydrate intake.	History of hypoglycaemia.	Overall: Very good. Some aspects of measurement missing.
Peveler, Davies, Mayou, Fairburn, & Mann, (1993) (36)	113	Cross-sectional interview study with questionnaires	Semi structured interview, self-report questionnaire, and medical monitoring.	Subjects were questioned in detail about insulin injections, including questions about taking injections regularly, and adjusting injections in response to test results.	Not labelled as adherence, but whether injections were taken regularly was measured, as was whether patients had attempted to adjust their insulin dose as a response to blood glucose test results to improve their blood glucose control.	98% reported taking their injections regularly, and adjusting their insulin dose in response to the test results at least occasionally. 60% had attempted to adjust their insulin dose in the light of test results in last month.	HbA1c	Overall: Excellent. Clearly described.

Currie et al. (2013) (41)	2946	Three-year retrospective case-note review	Clinician report - database records	Case-note review following up patients over time to assess outcomes. Patients had been given a diagnosis of non- compliance with medication at a clinical appointment during an initial 30-month observation period, which was recorded in their notes. How this decision was made was not described by the paper.	Patients were classified as medication non-compliant if this was recorded as a diagnosis in their medical notes.	2% were classified as medication non- compliant in the 30- month compliance assessment period.	None	Overall: Reasonable. Limited description
Thomson et al. (1995) (42)	122	Three-year retrospective case-note review	Clinician report - database records	Case-note review of patients who were admitted for ketoacidosis.	Insulin error or manipulation defined if notes in medical records documented that ketoacidosis had developed due to abnormal insulin treatment behaviour following an interview by diabetes team. How this was decided is not recorded by the paper.	Insulin error or manipulation was reported for 42% of young adults (under 25) and 11% of older adults (over 25)	None	Overall: Reasonable. Limited description.

Smith et al. (2009) (43)	31	Clinical audit group comparison study. Case-note review	Clinician report - database records	Case-note review – review of notes over 4 clinical visits where changes to insulin regime were discussed. The proportion of agreed changes to insulin regimen adhered to across visits one to four was calculated for each set of consecutive visits (one to two, two to three, and three to four). Patients scoring $\geq 50\%$ were defined as adherent. Adherence scores of the percent of advice taken were also measured.	Adhering to more changes to insulin regime between visits, and following a greater percentage of advice was taken as being more adherent.	Of those with hypo-glycaemia unawareness 54% were defined as adherent and they followed on average 19% advice, compared to those with awareness of hypo-glycaemia of whom 87% were defined as adherent and they followed 28% advice.	None	Overall: Reasonable. Limited description.
Vimalavathini, Agarwal, & Gitanjali, (2008) (44)	67	Intervention study of psycho-education for knowledge/adherence.	Medication monitoring	Patients had their blood plasma levels medically tested.	Adherence to insulin was defined as plasma insulin levels of at least 50% of their previous insulin dose.	Adherence increased from 82% to 86% following intervention.	Blood glucose, HbA1c, and plasma insulin.	Overall: Excellent. Clearly described.

Patient Self-report

Morisky Medication Adherence Scale

Two studies (27,28) used the Morisky Medication Adherence Scale (29), a previously validated scale for measuring adherence to medication which asks participants to respond to questions such as ‘Do you ever forget to take your medication?’ and ‘Are you careless at times about taking your medication?’ (p.69). Gomes and Negrato (27) used this four-item version (29), and adapted the questions from the original questionnaire to focus on insulin rather than medication in general, also changing the language of the questionnaire, for example ‘careless’ was exchanged for ‘negligent’. A strength of this measure is that it is specific to diabetes, and therefore may be relevant for this population. Farsaei et al. (28) used an eight-item version previously validated with people with type 2 diabetes in Thailand (30). However, Sakthong et al. (30) concluded that the 8-item measure had poor sensitivity in their type 2 diabetes population, and therefore may have failed to identify some people who were non-adherent. Both versions had a cut off score to define adherence and non-adherence. Neither version of this questionnaire has been validated in people with type 1 diabetes to the authors’ knowledge. Both studies using this scale have a quality rating of ‘excellent’ in terms of their methodology as reviewed by the current study, and the description of the assessment of insulin is clear in both cases and so could be replicated in further research.

Single question about frequency of missing insulin doses

Five self-report studies used for measurement a frequency measure for taking or missing insulin doses (28,31-34), such as “how often do you miss an insulin dose? (31)” and “did you take enough insulin to cover your food” (34). This method

provided a means of measuring change by allowing for a direct comparison over time following an intervention. However, it did not necessarily take into account the prescribed dose of insulin medication, or account for those who may be taking more insulin than they need. The methodologies for these studies were rated as excellent by the current paper, although two (32,33) did not report the precise wording of the measure used, making replication of their method more difficult. Additionally, these methods, while useful for quantifying adherence, do not provide any explanation about the reasons for adherence or non-adherence. None of these questions, to the authors' knowledge, had been validated for use in type 1 diabetes.

Clinical Interview about Adapting Insulin Dose

Two papers measured the extent to which insulin was adapted or adjusted in light of food, blood sugar readings, or physical activity (35,36). Both studies used cross sectional clinical interviews as well as questionnaires, which can provide a depth of understanding and quantitative data can also be collected and used for measurement. Peveler et al. (36) also used medical data alongside this which may have provided further information with which to interpret the responses of participants. This can be useful given that there is often some discrepancy between medical data and patient report (37). Both studies were clearly described and had very good and excellent methodologies as rated by the assessment tool.

Eating Disorders Research

Three of the self-report studies measured adherence to insulin only if associated with eating disorders, weight or food (34,38,39) Merwin et al, (38) used three items from the 16 item Diabetes Eating Problems-Revised (39), a self-report measure assessing

eating disorder behaviour and attitudes, creating a 'weight related insulin mismanagement' variable which was used to investigate associations with other variables. Takki et al. (11) measured, recorded, and quantified missed insulin doses only when they were missed primarily for the purpose of preventing weight gain. Merwin et al. (34) sampled participants with eating disorder symptomology, and used an automated telephone system asking them to respond to a question about whether they had taken enough insulin to cover their food, and recorded the frequency of these responses. These studies were included as they measured an aspect of adherence to insulin medication, and weight concerns have been strongly linked to insulin adherence in the literature (e.g.10,40), making measurement of this occurrence both important and helpful. However, it can be argued that by only focusing on weight related insulin mismanagement this may obscure other reasons for non-adherence, and therefore not offer a robust measure of insulin adherence more generally.

Case-note Review

Three of the papers identified (41-43) used this method and defined adherence based on historical patient case notes written by a clinician. This method of measuring insulin adherence allows the researchers to relatively quickly examine data from many patients, which may increase the generalisability of the findings. However, in all three of these studies, the way in which clinicians made a decision about adherence, and whether this was consistent between clinicians, was not reported. As a result, these studies scored more poorly for the description of the measurement of adherence, as although the method of coding the notes could be replicated based on

the descriptions, it was not possible to tell on what basis, or with what consistency, the original decision had been made. The quality of the methodologies overall was rated as reasonable.

Medical Monitoring

Vimalavathini, Agarwal, & Gitanjali, (44) used plasma insulin levels, and defined adherence to insulin as those patients with plasma insulin levels of at least 50% of their previous insulin dose. This method of measuring adherence controls for reporting bias such as under/over reporting by participants, and can provide an objective and measurable description of adherence. However, it also restricts the measurement to only the latest dose of insulin, and so cannot be used as a general measure of a person's adherence over time unless multiple samples are collected, as well as being labour intensive and costly (45). This methodology was clearly described, and rated as excellent by the assessment tool.

Discussion

This review identified studies reporting methods of assessing adherence to insulin medication in people with type 1 diabetes. It was identified that there were multiple definitions of insulin adherence and varying methodologies to measure this between the 14 included studies. A range of rates of adherence to insulin were also reported (10-99%, 27,28). This range of results is consistent with findings in a type 2 diabetes or mixed diabetes population (18,22,23,46). Compounding the problem of variation is the lack of clarity in the field about what constitutes 'good' insulin adherence. In a

review of medication adherence measures in type 2 diabetes (23), the authors comment on the ‘urgent’ need to develop consensus about what constitutes good adherence, as well as the need for consistency of measures and cut off points. The lack of consistency makes studies aimed at increasing adherence difficult to compare, and the current review illuminates a similar problem with measurement in type 1 diabetes.

The finding of self-report being the most common method of assessing adherence is supported by Clifford et al. (18), who find that all 14 studies carried out in a type 1 diabetes population included in their review use some form of self-report. Patient self-report is sometimes regarded as a somewhat unreliable source of information, as it is thought that patients may over-report their adherence (47). While this is the case in some studies, a review by Garber et al. (37) found that questionnaire and diary methods had moderate to high concordance with other measures sometimes used to assess medication adherence including drug levels, pill count, claims data, and clinical opinion. However, none of the questionnaires or single questions reviewed in the current study were empirically validated for use as a stand-alone measure of insulin adherence in a type 1 diabetes population to the knowledge of the authors. The questionnaire measures reviewed did not allow participants to record or explain their reasons for adherence or non-adherence, and it can be argued that collecting this information along with rates of adherence may be critical when considering interventions designed to improve adherence. Fairman (45) recommends that questionnaire items should be carefully constructed in order to “avoid the implication that non-compliant patients are in some way derelict” (p.500). It is feasible in the opinion of the authors of the current study that wording such as

‘negligent’ or ‘careless’ used in the Morisky Medication Adherence Scale and adaptation (27,29) may carry this implication. Clinical interviews, although providing a depth of information, may be time consuming for both the clinician and the participant (45). Database methods assessing clinical opinion may offer a time efficient way to collect adherence data on a large number of participants, but there may be issues around reliability and validity, as no depth of information can be gathered, and consistency between clinicians is not controlled (or at least, not described by the papers). Finally, medical monitoring can provide an objective measure of adherence, which controls for under or over reporting by patients. However, the method described in this review would require routine testing of plasma levels, which may be time consuming for the clinician, and the patient, and again does not allow for exploration of why patients may not be adherent with their insulin regime.

The current review also highlights the relative inequality in the number of studies on insulin adherence conducted in people with type 1 diabetes compared to type 2 diabetes (22,23). Despite the broader inclusion criteria (not restricted by date or study design), only 14 studies could be identified, which is considerably fewer than identified by previous reviews of predominantly type 2 diabetes or mixed type 1 and type 2 studies (17,18,22,23,46). A more detailed discussion of these results is available in Chapter 6 – Discussion.

Strengths and Limitations

This paper only reviewed articles available in the English language, and only those that were published, as ‘grey literature’ or articles currently in press were not actively sought out. One reviewer (SA) conducted the literature search, data extraction, and data synthesis, meaning that the potential for studies to be missed and the risk of bias was greater than if this had been co-reviewed. The search was limited to articles published on the databases searched. Compared to previous systematic reviews in this area, a relatively small number of papers met all inclusion criteria. Pre-defined eligibility criteria were used, and PRISMA guidelines (13) were followed, which contributed to the robustness of the review.

Recommendations

There are advantages and disadvantages of each of the methods described and reviewed, which should be considered when assessing whether they can be recommended as an appropriate standardised measure of insulin adherence moving forwards. The majority of studies used self-report measures, which have the advantage of being relatively practical to administer. Questionnaires and diaries in particular have been found by Garber (37) to have higher concordance with other measures of medication adherence when compared with interview methods. Existing self-report measures do not explore the reasons for non-adherence, there is no agreed definition of when adherence is achieved, and none of the measures reviewed had been validated specifically in a type 1 diabetes population. The conclusions of this review support the case for the development and validation of a measure of insulin

adherence for type 1 diabetes that incorporates patient involvement to promote acceptability, is empirically validated in order to be sure of validity and reliability, is time efficient for both clinicians and patients, and allows for recording of reasons for non-adherent behaviour, allowing information crucial for interventions promoting adherence to be collected. Further, the inequality in the number of studies on insulin adherence in type 1 diabetes compared to type 2 diabetes, and the mixing of these populations in research highlights a need for more research to be carried out with those with type 1 diabetes, to ensure that resources and interventions can be tailored appropriately to meet the needs of this population.

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Chapter Two

Bridging Chapter

Insulin Adherence and Insulin Omission

This chapter aims to provide a bridge between the systematic review and the empirical study carried for this project by defining the terms used, and by introducing insulin omission.

2.1 Insulin Adherence

The current systematic review focuses of the topic of insulin adherence. The term ‘adherence’ has been defined by the World Health Organisation, as “the extent to which a person’s behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health-care professional” (Sabaté, 2003, p. 3). Medication adherence in particular has been defined as “whether patients take their medication as prescribed (e.g. twice daily), as well as whether they continue to take a prescribed medication” (Ho, Bryson, & Rumsfeld, 2009 p. 3028). Medication adherence in people with type 1 diabetes refers to insulin, given that insulin is the medical treatment for people with type 1 diabetes recommended by The National Institute of Clinical and Health Excellence guidelines (NICE, 2016). This is distinct from medication adherence in type 2 diabetes as people with type 2 diabetes may also take medication in oral form, such as oral hypoglycemic agents (Inzucchi, 2002), and may only need to take insulin when the disease has progressed (Taylor, 2013). As the current systematic review describes, previous research has sometimes combined these different types of medication adherence along with types of diabetes (e.g. Clifford, Perez-Niever, Skalicky, Reaney, & Coyne, 2014). For the purposes of the current research, and in reference to type 1 diabetes, ‘insulin adherence’ refers to when insulin is taken as prescribed (Stolpe, Kroes, Webb, & Wisniewski, 2016).

2.2 Insulin Omission

2.2.1 Definitions

The term insulin omission, as noted in the current systematic review, is a specific type, or subsection, of insulin adherence. Insulin omission has been defined as when “...inadequate insulin is injected for the calories ingested, blood glucose may increase markedly. As a consequence, glycosuria occurs and the volume of urine produced increases. The end result is the excretion of large amounts of glucose (and thus calories) in the urine, resulting in short-term reduction in weight from fluid loss and some caloric restriction.” (Crow, Keel, & Kendal., 1998, p. 234). Insulin omission can be referred to as the missing of insulin doses completely (Peyrot, Rubin, Kruger, & Travis, 2010), while the term insulin restriction has been used when individuals choose to take less insulin than they need (Goebel-Fabbri et al., 2008). Insulin non-adherence may comprise these two behaviours, and can also include taking more insulin than would be recommended (overdosing), and/or taking the correct amount of insulin but taking it at the wrong time (Brod, Rana, & Barnett, 2012). Furthermore, insulin non-adherence may incorporate other behaviours that make it difficult to adhere fully to the prescribed insulin dose, such as not checking blood glucose levels (Miller et al., 2013). As the current systematic review details, studies measuring insulin adherence have often chosen one particular category or definition of insulin adherence on which to base their measurement, such as insulin restriction (Merwin et al., 2015), or adaptation of insulin dose to test results (Gurkova & Ziakova, 2014). In the current empirical study insulin omission is defined as when insulin doses are missed completely, insulin restriction is defined as when doses are reduced, synonymous with under-dosing, and overdosing is defined as when more insulin is taken than required.

2.2.2 Short-term Effects of Insulin Omission

Insulin omission has been linked to poorer blood glucose control because when insulin is omitted, the body is not able to absorb sugar, resulting in hyperglycemia (Randløv & Poulsen, 2008). The short-term consequences of hyperglycemia include passing more urine than usual, becoming very thirsty, headaches, tiredness, and weight loss (Diabetes UK, 2017a). In severe cases, a lack of insulin can result in diabetic ketoacidosis (DKA). This occurs when the body, in the absence of glucose, starts to break down other body tissues for energy. Chemicals known as ketones are a by-product of this process which, if allowed to build up, can be fatal (Diabetes UK, 2017b).

2.2.3 Long-term Effects of Insulin Omission

The potential long-term consequences of persistently high blood glucose levels include a number of macrovascular and microvascular complications, such as blindness, kidney failure, foot ulceration which can lead to amputation, premature heart disease, and stroke (NICE, 2016). National guidance for the treatment of type 1 diabetes (2016) states that the risk of these complications is greatly reduced by the appropriate management of blood sugar levels through, in part, adherence to insulin medication.

In an 11-year longitudinal study of 234 women, Goebel-Fabbri et al. (2008) identified 71 women and adolescents who reported insulin restriction at baseline. They defined this insulin restricting group as women who responded affirmatively to the question “I take less insulin than I should”. They reported that at follow up, those who had restricted insulin had a three times higher risk of mortality, were more likely to have died younger (mean age 45 vs. 58 years), and that they also had higher rates of nephropathy (kidney damage) and foot problems.

2.2.4 Insulin Omission and Eating Disorders

As described by Crow et al. (1998), insulin omission results in sugar and subsequently also calories being excreted from the body in the urine. This results in a temporary weight loss, and insulin omission has most commonly been studied as for the purpose of achieving weight loss (e.g. Takki et al., 2008 Peveler et al., 2005; Pinhas-Hamiel et al., 2013).

In a study investigating the effects of insulin omission in relation to eating disorders, Takii et al. (2008) defined insulin omission as “omission/reduction by participants of at least one quarter of the prescribed insulin mainly for the purposes of preventing weight gain” (p. 260). In their sample of 109 females with type 1 diabetes and clinical eating disorders, they found that duration of severe insulin omission was the factor most closely associated with retinopathy (eye damage) and neuropathy (kidney damage) when compared to the duration of self-induced vomiting and duration of binge eating. This indicates that although their sample may have had other physical complications associated with eating disorders, insulin omission played the largest role in the poor health outcomes of these women.

Also in relation to eating disorders, Peveler et al. (2005) conducted a longitudinal study of women with type 1 diabetes, and measured participants as ‘misusing’ insulin if they reported intentionally reducing or omitting their insulin dose to control their weight. They found that in their sample of women age 20-38 year (after 8-12 year follow up from baseline), there was strong relationship between a history of insulin misuse and hospital admissions for DKA.

The use of insulin omission as a method of weight control or prevention of weight gain may meet the criteria for bulimia nervosa as specified by the diagnostic and statistical manual of mental disorders (DSM-V; American Psychiatric

Association, 2013), which states, as a criterion for diagnosis, “recurrent inappropriate compensatory behaviours in order to prevent weight gain such as... misuse of laxatives, diuretics, or other medications” (p. 345). This association has led to the term ‘diabulimia’ being coined, referring to when individuals with diabetes omit insulin as a means to control their weight (Ruth-Sahd, Schneider, & Haagen, 2009).

While research has found insulin omission for weight control to be a consistent finding, other reasons for omission are also implicated. Polonsky et al. (1994) found that although just over half of their participants who omitted insulin did so as a means of weight control, the remainder did so for other reasons which were not investigated (or not reported). Three studies to the knowledge of the author have specifically explored potential reasons for insulin omission in addition to weight control, (Sullivan, 2012; Peyrot, Barnett, Meneghini, & Schumm-Drager, 2012a; Farsaei, Radfar, Heydari, Abbasi, & Qorbani, 2014). Findings from these studies suggest that, ‘stress and emotional problems’ (Peyrot et al., 2012a), ‘delaying and then forgetting’ (Sullivan, 2012), and ‘embarrassment’ (Farsaei et al., 2014) are also important factors in the role of insulin omission. There is considerable variability in the reported findings however, and reasons for insulin omission is an area that the current empirical study intends to explore in more detail.

2.3 Physical Health and Mental Health

Research has established a consistent link between the incidence of poorer physical health and poorer mental health (Naylor et al., 2016). Those with long-term physical conditions have been found to be more likely to develop mental health difficulties, and those with mental health difficulties have been shown to have a higher risk of developing physical health complications or conditions (Scott et al.,

2009; Robson & Gray, 2007, Stein, Cox, Afifi, Belik, & Sareen, 2006). A recent publication by The King's Fund (Naylor et al., 2016) highlighted the number of ways in which mental health and physical health can impact upon each other, including the side effects of medication (e.g. steroids, or psycho-tropic medication), the psychological impact of living with a chronic condition, and the direct effects of stress on the cardiovascular, nervous, and immune systems.

Diabetes has not been excluded from this trend, and research shows that those living with schizoaffective disorder have approximately five times higher rates of type 2 diabetes than would be expected in the general population, and that those with bipolar disorder have two times higher rates (Regenold, Thapar, Marano, Gavimeni, & Kondapavuluru, 2002). Further, a review by Barnard, Skinner, and Peveler (2006) revealed that the prevalence of clinical depression in those with type 1 diabetes was around four times higher than non-depressed control group subjects.

Of significance, a meta-analysis conducted with studies including type 1 and type 2 diabetes demonstrated that those with both diabetes and depression were more likely to develop diabetes related complications compared to non-depressed control groups with diabetes (De Groot, Anderson, Freedland, Clouse, & Lustman, (2001). There are number of possible explanations for the poorer health outcomes in those with both diabetes and depression, including poorer diet and functional impairment compared to non-depressed people with diabetes (Ciechanowski, Katon, & Russo, 2000). However, a previous meta-analysis by Gonzalez et al. (2008) has found that depression symptom severity is associated with non-adherence to diabetes regime, which indicates that non-adherence may, in part, explain the worse outcomes in those with depression and diabetes. Furthermore, depression has been specifically linked to insulin omission in those with type 1 diabetes, with Trief et al. (2014),

reporting that people with symptoms of depression were more likely to omit insulin. Given the established link between insulin adherence, poorer blood glucose control, and physical health complications as discussed, the role of mood is an important area for research, and will be considered alongside potentially related concepts such as self-efficacy in the empirical paper.

2.4 Insulin Injections and Insulin Pumps

While the traditional method of insulin delivery is via injections, and measures of insulin adherence and omission are often phrased using the word injection (e.g. Louch et al., 2013), more recently insulin pumps have become available as an alternative method of administering insulin doses (Diabetes UK, 2017c). Insulin pumps are a battery operated device that provide the body with regular doses of insulin throughout the day. This can be done automatically, eliminating the need for injections, although additional doses are able to be programmed when needed (for example at meal times depending on carbohydrates ingested), and blood sugar levels still need to be checked to inform decisions about additional doses. Insulin pumps can be purchased by those with diabetes, or are available from the NHS in cases where despite good adherence, a person's blood sugar is still not well controlled (Diabetes UK, 2017c). A list of the advantages of insulin pumps over injections is available from diabetes.co.uk (2017) in their article 'Multiple daily injections vs insulin pumps', retrieved from <http://www.diabetes.co.uk/insulin/mdi-vs-insulin-pumps.html>. There is evidence that being given an insulin pump improves a person's adherence (Pickup, Mattock, & Kerry, 2002).'

Chapter Three

Empirical Paper

Investigating insulin omission and the relationship with self-efficacy, depression,
and diabetes self-management in adults with type 1 diabetes.

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*This paper has been written in accordance with word count and formatting guidance
for Diabetes Care (Appendix A)*

Abstract

Objective

Many people with type 1 diabetes find it difficult to adhere to their insulin medication regime, and may omit or restrict their recommended insulin doses. This is associated with an increase in complications and mortality rates. To date no study has explored this behaviour in relation to self-efficacy, and research in this area has been hindered by the lack of an appropriate measure of insulin omission. The current study aimed to investigate the relationship between insulin omission, diabetes self-management, mood, and self-efficacy, as well as the reasons for omission, using a self-report measure of insulin omission developed for the purposes this study.

Research Design and Methods

This cross-sectional online survey included 231 participants who completed questionnaire measures of general self-efficacy, diabetes specific self-efficacy, depression, diabetes self-management, and an insulin questionnaire developed for this study. The insulin questionnaire was designed to collect both quantitative and narrative data which requested participants' reasons for omitting insulin.

Results

Group comparisons using either independent t-tests or Mann-Whitney tests revealed that insulin omission was associated with lower general self-efficacy, lower diabetes specific self-efficacy, higher depression scores, and poorer diabetes self-management (all $p < .001$). Thematic analysis of the narrative data revealed a number of themes that characterised insulin omission, including a) Prioritising: forgetting

and the demands of daily lifestyle, b) Diabetes related emotional distress, c) Weight control, d) Avoidance: Fear of physical effects, and e) Adaptive responses to managing blood sugar levels.

Conclusions

This study illuminates the role of self-efficacy and depression in insulin omission in relation to both quantitative and narrative findings.

Introduction

Research suggests that many people with diabetes find it difficult to adhere to their recommended insulin regime (1,2), which is an essential part of the management of type 1 diabetes as recommended by The National Institute of Clinical and Health Excellence guidelines (3). Individuals with type 1 diabetes may on occasion choose to take less insulin than recommended, or to miss out insulin doses completely (4). This behaviour is referred to as ‘insulin restriction’ (5) and ‘insulin omission’ (2) respectively. These can be considered to reflect specific areas of adherence (or non-adherence), commonly defined as whether patients take their medication as prescribed (6), to insulin medication. Adherence to insulin medication is in turn part of the broader self-management of diabetes, which also includes monitoring of physical exercise and activity, monitoring of blood sugar levels, and nutritional management (3,7).

Insulin omission and restriction have been linked to significantly poorer long-term physical outcomes (5,8). Polonsky and colleagues found that women who omitted

insulin had more diabetes related hospital admissions and higher rates of retinopathy and neuropathy compared to those who did not (8). Goebel-Fabbri and colleagues found in an 11-year longitudinal study, that women with type 1 diabetes who reported insulin restriction were three times more likely to have died, died prematurely (mean age 45 vs. 58 years), and present with more complications, compared to those who reported not restricting insulin (5).

Despite the harmful consequences of this behaviour, there is a limited understanding as to why people do not always take insulin medication as prescribed (9).

Researchers have more commonly investigated the general self-management of diabetes, and as a result self-management has been empirically linked to a number of risk factors and psychological constructs. Poorer self-efficacy, defined as ‘an individual’s judgment of his or her capabilities to organize and execute a course of action’ (10 p.197) has been associated with poorer diabetes self-management in different ethnicities and levels of health literacy (11,12). Bandura’s social learning theory (13) states that individuals perform activities that they perceive that they can cope with and avoid activities which they do not believe that they can cope with. It may therefore follow that that low self-efficacy can lead to avoidance, which may take the form of insulin omission. However, no study to date has investigated self-efficacy in relation to insulin omission.

Depression has been linked to poorer diabetes self-management (14,15) and to insulin omission specifically in people with type 1 diabetes (16). Trief et al. used questionnaires on enrollment to an endocrinology clinic, and reported that participants with symptoms of depression were more likely to miss insulin doses

(16). However, Peyrot et al. using a web survey found no association between a history of depression and reported insulin omission in those with type 1 or type 2 diabetes combined (2). Additionally, in the three existing studies looking at reasons for insulin omission, Sullivan (17), using interview methods, found that participants with type 1 diabetes did not report low mood or depression as a reason for or explanation of insulin omission, and Farsaei et al. (18) using a telephone survey did not report mood as one of the reasons for insulin omission. Peyrot et al. (19), using a web survey, did not report any findings relating to depression, but found that ‘stress or emotional problems’ was the fourth most common reason selected by participants with type 1 or type 2 diabetes to account for insulin omission. These inconsistencies in the reporting of and role of depression indicate that further investigation is required. As there are known interventions for depression, and for low self-efficacy in managing diabetes (20,21), ascertaining the link between these constructs and insulin omission may helpfully inform or develop these interventions.

The discrepancy in findings of whether mood may lead to, or be a consequence of, insulin omission alludes to a variety of measurement issues associated with the assessment of insulin omission. First, the use of samples combining responses from those with type 1 and type 2 diabetes has led to a lack of clarity, given evidence that differences exist in insulin omission between these groups. Peyrot et al., (2) found that those with type 2 diabetes were more likely to omit insulin than those with type 1 diabetes. In addition, risks factors for the presence of insulin omission in these groups were different, with diet non-adherence being more prominent in type 1 diabetes, and demographic factors such as income, education, and age playing more of a significant role in those with type 2 diabetes (2). Second, as described with the

role of mood and insulin omission, there is evidence that different methodologies used to assess insulin omission may produce different results. This may be in part because participants fear a lack of confidentiality, or judgment from the researcher (22). For example, a meta-analysis by Weisband and Kiesler (23) found that computer administered assessment methods were associated with increased disclosure of personal information. This was particularly with medical patients, and specifically when the information was considered sensitive. Third, there is inconsistency in the assessment and definition of insulin omission and of insulin adherence more widely (1,24). Researchers have attempted to measure this in a number of ways. For example, interview methods (25), questionnaires asking for responses to series of questions including ‘are you negligent at times about taking your insulin medication?’(26), or a single-item – “How often do you skip insulin injections that you know you should take?” (2) There is currently no consensus on how omission or adherence should be assessed, the time-period that this assessment should be based on, or conversely what constitutes good adherence (1,24). This has resulted in the lack of an assessment tool available for clinicians to use when screening new or existing patients in routine clinical practice for deviations from prescribed insulin.

This study aimed to investigate the relationship between insulin omission, self-efficacy, mood, and diabetes self-management in adults with type 1 diabetes. It aimed to address some of the measurement issues outlined by developing a method of measuring omission that was anonymous, was designed to be based on findings from the limited existing research in this area, and selectively recruited people with type 1 diabetes. A type 1 diabetes population was selected due to the comparative

scarcity of research on insulin adherence in this group, compared to type 2 diabetes, or mixed studies (1,24,27,28) The measure was designed to collect both quantitative and narrative data, allowing exploration of the reasons for insulin omission, and examining associations with depression and self-efficacy.

Research Design and Methods

This cross sectional web survey included a number of self-report questionnaires that were designed to collect both quantitative and narrative data.

Participants and Procedure

Participants were recruited online via a poster advertising a link to the survey which was hosted by diabetes related media platforms, including Twitter, Facebook groups, and diabetes information websites such as Diabetes UK. Posters were also displayed in the waiting room of an NHS diabetes clinic at the Norfolk and Norwich University Hospital. Participants were eligible to take part if they were aged 18-65 years, had a diagnosis of type 1 diabetes for more than one year, lived within the European Union (in order that a single ethical legal process could be followed), and read fluent English. G* Power version 3 was used to calculate an estimate of the number of participants needed for the analysis of quantitative measures based on anticipated correlations in order to detect an effect size of 0.2, which indicated an appropriate sample size of 191 participants. The study was therefore correctly powered. Additional information about the procedure and rationale is provided in Chapter 4 – Extended Methodology.

Measures

General self-efficacy

The New General Self-Efficacy Scale was used to explore whether a relationship similar to the one observed between self-efficacy and diabetes self-management was also present between self-efficacy and insulin omission. This eight-item self-report measure was found to be valid and highly reliable when compared by the authors with other measures of self-efficacy, demonstrating a Cronbach's $\alpha = .85$. Higher scores are indicative of greater self-efficacy (26).

Diabetes specific self-efficacy

A measure of diabetes specific self-efficacy was used in order to differentiate general self-efficacy from self-efficacy relating specifically to diabetes. The Diabetes Empowerment Scale – Short Form, an eight-item self-report single factor scale, was found to be valid and reliable measure of diabetes related psycho-social self-efficacy with Cronbach's $\alpha = .84$. Higher scores are indicative of greater self-efficacy (30).

Depression

Measuring depression allowed for the exploration of a quantitative relationship between mood and insulin omission in this population. As a measure of depression, the Patient Health Questionnaire – 9 (PHQ-9) was used. This nine-item single factor

self-report scale was developed, validated, and found to be reliable by Kroeke, Spitzer and Williams (31), with a Cronbach's $\alpha = .89$, and is widely used in healthcare. This measure has more recently been validated for use with diabetes patients (32). Higher scores are associated with greater severity of depression. The measure was used as a continuous scale rather than imposing a categorical cut-off in order to increase sensitivity, and in response to doubts about the ability of a questionnaire measure to appropriately categorise depression in those with diabetes (33).

Insulin Omission

An initial questionnaire was developed for the purposes of this study based on information drawn from a variety of sources. This included material developed from the limited research available assessing insulin omission (2,8,9,16). In addition, new items were generated, designed to allow participants to write freely about their reasons for insulin omission, and to ascertain any associations with mood. Once the questionnaire had been developed, a five-stage consultation process involving professionals working in diabetes and patients with type 1 diabetes took place. The range, form, and content of the questions were discussed and feedback was obtained, with changes made to the measure reflecting this, including the addition of new items. The final questionnaire contained 16 questions which assessed insulin omission. The frequency of missing doses and the frequency of taking less or more insulin than needed was assessed e.g. 'Do you ever skip (miss out) insulin doses that you know you should take?' 'Do you ever take less or more insulin than you know you should?' Participants were asked in open ended questions why they engaged in

this behaviour, in response to the question ‘Could you explain in your own words why you skipped an insulin dose that you knew you should take?’, and whether this was linked to mood, by responding to the question ‘Does your mood effect how you take insulin?’, and ‘Does taking insulin effect your mood?’ ‘If so, how?’. Further detail on the development of this measure is provided in Chapter 4 – Extended Methodology.

Self-management of diabetes

Since this project involved the development of a new assessment tool, the inclusion of a measure of diabetes self-management allowed the variables of interest in this study to be explored against a previously validated measure. It also allowed for the association between self-management and insulin omission to be reported. The 16-item self-report Diabetes Self-Management Questionnaire (DSMQ) was selected as a recent, validated questionnaire that had strong associations with HbA1c levels and good internal consistency (overall Cronbach’s $\alpha = .84$) (34). Participants were asked to consider their diabetes care over the last eight weeks, with questions focusing on glucose management, dietary control, physical activity, and health care use. The questionnaire generated an overall sum-scale, as well as four factors including health care-use, physical activity, dietary control, and glucose management. Higher scores were indicative of better self-management.

Analysis Plans

Quantitative data from the questionnaires were analysed using the statistical package SPSS version 22. Bivariate analyses were carried out to identify factors related to diabetes self-management and insulin omission. Where data did not meet parametric assumptions, non-parametric alternative tests were used in place of parametric testing.

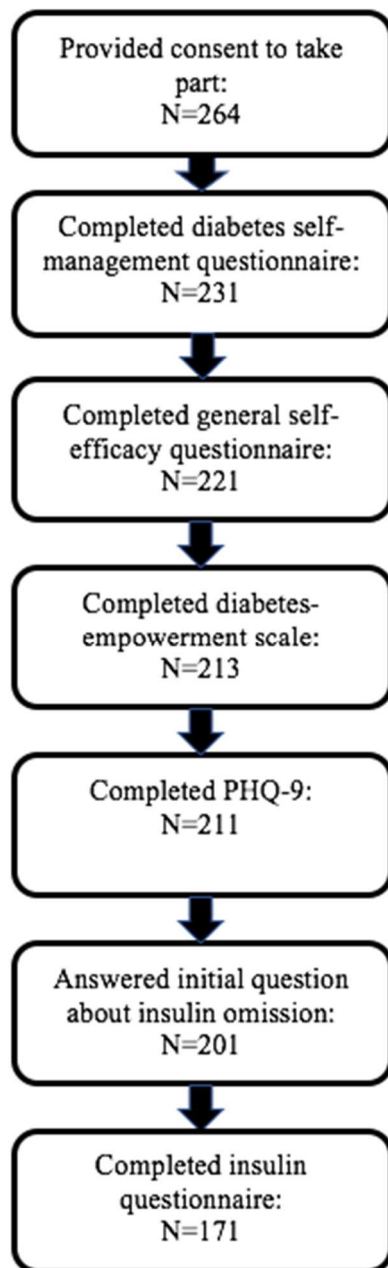
Narrative data collected were analysed in a qualitative software package (NVivo 11 QSR) using thematic analysis (35). Data were read and reread, and categorised into key phrases to generate initial codes relating to insulin omission by the primary researcher SA. These codes were discussed with BT and SC, and a list of second code cycles were created. The data were then reread with the revised coding framework applied, leading to a final five themes. Themes were identified at a semantic level, and the researchers took an essentialist approach, assuming that the language used reflected and enabled meaning and experience to be articulated.

Results

Participant Characteristics

Between August and November 2016, a total of 264 participants provided consent to take part in the study. Of these, 231 completed and met the inclusion criteria, and took part in the survey, with 171 (78% female 22% male) completing the questionnaire. See supplementary figure 1 which depicts this. The responses of

participants who withdrew mid-way through a single questionnaire were included in analyses providing more than 75% of that questionnaire was completed (missing data points were imputed using average scores for the relevant questionnaire).



Supplementary Figure 1: Response rate to online questionnaire

Participants were aged between 18-65, and 95% of those who took part were living in the UK. Forty-six percent reported being on an insulin pump, with the remaining

54% taking insulin injections. Participants had been on their current regime of treatment for an average of 5-6 years, and the mean age fell within the age bracket 34-41 years old. Approximately 30% (60/201) of responders answered yes to the question 'do you ever skip (miss out) insulin doses that you know you should take?', and were coded in the 'omission' group for analyses. Four per-cent (10/201) reported they had omitted insulin seven or more times in the last week. Around half (99/199) of responders answered yes to the question 'do you ever take less or more insulin than you know you should?' Forty eight percent (96/201) of responders reported either omitting or restricting insulin with 41% (81/199) of respondents reporting always taking insulin as they should. See Table 1 for participant characteristics.

Chi squared tests were used for categorical data. Those who those omitted insulin were significantly younger than those who did not [$\chi^2(5) = 17.3$]. Differences in gender and method of delivery of insulin were not statistically significant in those who reported omitting insulin and those who did not. [$\chi^2(1) = 1.67$], and [$\chi^2(1) = 3.13$] respectively.

Table 1: Participant characteristics

Variable	No insulin omission	Insulin omission	P value
Insulin omission	141 (70%)	60 (30%)	-
Restricting insulin (not overdosing)	19 (13%)	20 (33%)	-
Overdosing insulin (not under dosing)	22 (16%)	3 (5%)	-
Both restricting and overdosing insulin	17 (12%)	19 (32%)	-
Gender Female	105 (75%)	50 (83%)	.27
Injections	72 (51%)	39 (65%)	.09
Age	3.35 (.28) = age bracket 34-41	2.48 (.18) = age bracket 26-33	.004*

Continuous data are presented as mean (SD) and categorical data as n (%)

Percentages reported are % participants in each insulin omission group who also fall into the category described.

*P<.01

Group Comparisons

Group comparisons were used to investigate differences between those who reported omitting insulin and those who did not. Depending on whether data met parametric assumptions, either independent samples t-tests (using an adjustment for the significance of Levene's test of homogeneity of variance if indicated) or Mann-Whitney tests were used. Parametric assumptions results are available in Chapter 5 – Extended Results. Insulin omission was related to diabetes self-management scores with a large effect size. Differences between those who omitted insulin and those who did not were significant across all measures investigated. Those who reported insulin omission were more likely to have lower general self-efficacy ($p < .001$), lower diabetes specific self-efficacy, ($p < .001$), higher depression scores ($p < .001$), and poorer self-management ($p < .001$). See Table 2.

Table 2: Group comparisons using T – test or Mann-Whitney

Variable	No insulin omission Mean (SD)	Insulin omission Mean (SD)	Test result	P value	Effect size
Depression	6.05 (5.61)	11.01 (6.95)	U =6026	<.001	r = 0.35
General self- efficacy	24.46 (4.41)	21.61 (5.37)	t(95) = 3.61	<.001	d = 0.58
Diabetes specific self-efficacy	29.60 (6.06)	24.53 (7.19)	U = 2462	<.001	r = 0.33
Diabetes self- management total score	35.88 (5.85)	25.50 (10.15)	t(76) = 7.41	<.001	d = 1.25
<i>Health care use</i>	8.11 (1.41)	6.40 (2.66)	U = 2543	<.001	r = 0.33
<i>Physical activity</i>	6.20 (2.26)	5.30 (2.50)	t(198) = 2.50	.013	d = 0.38
<i>Dietary control</i>	5.95 (2.46)	4.13 (3.00)	t(198) = 4.51	<.001	d = 0.66
<i>Glucose management</i>	13.04 (2.27)	8.15 (3.95)	U = 1199	<.001	r = 0.57

Correlations

Correlations were used to investigate relationships between continuous variables across the complete participant sample. Pearson's correlation co-efficient was calculated to measure relationships between depression, general self-efficacy, and diabetes specific self-efficacy. Kendal's tau correlation co-efficient was computed to investigate relationships that included diabetes self-management due to the non-normal distribution of data across this variable. All variables were significantly related to all other study variables at the $p < .01$ level (see correlation matrix displayed in Table 3). Results demonstrated that those with poor diabetes self-management also had higher depression scores, lower general self-efficacy scores, and lower diabetes specific self-efficacy scores. Those with higher depression scores also had lower general self-efficacy scores, and lower diabetes specific self-efficacy scores. Those with higher general self-efficacy scores also had higher diabetes specific self-efficacy scores.

Table 3: Correlation matrix demonstrating relationships between study variables

	Depression	Diabetes related self- efficacy	General self- efficacy	Diabetes self- management
Depression	-	$r = -.61^*$	$r = -.60^*$	$r\tau = -.41^*$
Diabetes related self- efficacy		-	$r = .52^*$	$r\tau = .44^*$
General self-efficacy			-	$r\tau = .32^*$
Diabetes self- management				-

* $p < .01$

Open-Ended Response Analysis Results

A total of 123 of the 231 respondents to the survey (53%) provided a response to one or more of the open-ended questions inviting further comments about insulin. In total 57 of the 60 respondents (95%) who reported insulin omission also provided a comment about why. Over 90% of these comments were encompassed in the following five themes, using the six-stage process outlined by Braun and Clarke (31): a) Prioritising: Forgetting and the demands of daily lifestyle. This was the most commonly reported reason for insulin omission with 57% of those who omitted insulin giving this as the primary reason. Respondents reported a variety of lifestyle factors such as parenting responsibilities, feeling unable to take a break from work, or simply forgetting. b) Diabetes related emotional distress was reported by 15% of

those who reported insulin omission. Participants described feelings of resentment, frustration, or hopelessness towards their diabetes as reasons for insulin omission. Answers indicated a two-directional relationship between mood and insulin omission, with 60% of those who omitted insulin reporting that their mood affects how they take insulin, 43% reporting that taking insulin affects their mood, and 28% reporting both of these. c) Weight control. The use of insulin omission for weight control was described by 13% of those in the insulin omission group, making it the third most common reason given. Participants reported that they engaged in this behaviour to either lose weight, or to prevent weight gain. d) Avoidance: Fear of physical effects. Ten percent of participants reported fear based reasons for insulin omission, in particular a fear of hypoglycemia, or of injections. e) Adaptive responses to managing blood sugar levels were reported by 7%. Participants explained that sometimes as part of the effective management of their blood sugar, they needed to omit insulin doses, for example before exercise. Table 4 presents illustrative quotes of these themes. A more detailed account of the results from this question, as well as the results from other questions on the questionnaire, are provided in Chapter 5 – Extended Results.

Table 4: Quotations from thematic analysis of narrative comments

Theme	Representative quotations
a) Prioritising: Forgetting and the demands of daily lifestyle	<p>‘Occasionally I am so tired. By the time I go to bed I cannot manage to take my injections and meds.’</p> <p>‘Didn't skip but when entertaining or serving a big family meal I sometimes put it off until everyone is served then forget.’</p>
b) Weight control	<p>‘To lower my weight, I have gained a stone and I know as a quick fix, running my sugars high will give me a quick weight loss.’</p> <p>‘Taking the insulin can lead to weight gain.’</p> <p>‘In order to reduce current weight and/or to avoid the possibility of putting on weight on with increased insulin doses.’</p>
c) Diabetes related emotional distress	<p>‘To be in control of my own body.’</p> <p>‘Most of the time it's because I feel so down about my poor control that I don't see the point in trying.’</p> <p>‘Sometimes I get so angry about having type 1 diabetes.’</p>
d) Adaptive responses to managing blood sugar levels	<p>‘Towards the end of the day. If I have not eaten that much in a day I think that my sugar levels will be low enough that I don't need additional insulin to cope with the food intake.’</p> <p>‘I had low blood sugar and I wanted to avoid hypoglycemia.’</p>
e) Avoidance: Fear of physical effects.	<p>‘Anxiety over injections.’</p> <p>‘Was worried I took a hypo and nobody would be there to help even though I know deep down I can help myself with hypos.’</p>

Conclusions

A relationship between self-efficacy and insulin omission had not previously been investigated, and so this is a novel finding. Participants who omitted insulin were more likely to report lower levels of self-efficacy, more depressive symptoms, and poorer diabetes self-management. The finding in relation to mood and diabetes management is consistent with previous research (16).

The rate of omission and/or restriction (48%) reported in the current study was generally higher compared to previous research using similar methods of assessment. e.g. 31% and 33% (8,19). The way omission and restriction were assessed (self-report yes/no with no time scale) was similar to these previous research studies to allow for comparison. Previous studies have used different methods of data collection (telephone and clinic based interviewer questioning) which did not allow for anonymous responding. It is possible that the higher prevalence in this study may reflect the anonymous style of data collection, allowing for a reduction in fears about disclosure (22,23). The higher rates of (only) insulin omission found in a non-anonymous web survey by Peyrot et al. (2, 57% compared to 30% in the current study) may have been due to the inclusion of people with type 2 diabetes, whom they identified were more likely to omit insulin (2).

The relationship demonstrated between self-efficacy and insulin omission found in the current study supports previous findings that greater diabetes specific self-efficacy predicted less omission of medication in those with type 2 diabetes (36). The design of the current study did not allow us to infer whether those who were

more self-efficacious were more likely to take insulin as prescribed, or whether missing insulin doses led patients to feel that they were less efficacious and could not cope with their diabetes and life generally. Bandura (13), states individuals will engage in activities that they feel able to cope with, and avoid those that perceive that they cannot cope with. It may be that when individuals feel unable to cope with their diabetes they respond with avoidance of insulin, resulting in insulin omission. This view is supported by a number of participants in the study who wrote about feeling unable to cope with low blood sugar, or injections, and explained or inferred that as a result of this, they subsequently omitted insulin.

This study demonstrates that the relationship between mood and diabetes self-management is complex, with insulin omission playing a significant role.

Quantitative measurement showed that those with higher scores on the measure of depression were more likely to omit insulin. This supports the findings of Trief et al (16), who reported that in their sample, participants with depression were more likely to miss insulin doses. Respondents in the current study suggested a two-directional relationship between mood and insulin omission, with mood affecting how participants took their insulin, and taking insulin impacting on the mood of participants. The direction of the relationship between mood and medication adherence has been studied in type 2 diabetes by Gonzalez et al. (37), who found that depression was a risk factor for poor medication adherence. Further research is required to establish whether this is also the case in type 1 diabetes, and whether it applies to insulin omission.

Recognising the relationship depression and self-efficacy have with insulin omission

may encourage clinicians to consider these factors when assessing patients presenting with insulin omission, and consider the evidence based treatments that might helpfully be applied in such cases (20,21).

The themes generated from the narrative accounts are consistent with existing research on insulin omission. Insulin omission is commonly associated with the desire for weight control and for the purpose of weight loss (5,8,38), due to the excretion of sugar and subsequently calories in the urine when insufficient insulin is taken for the food consumed (4). The current study supports this finding with a clear theme of 'Weight control' emerging. A variety of alternative themes also emerged and these are also reflected in previous research. The theme of 'Prioritising: Forgetting and the demands of daily lifestyle', resonated with the most common responses of 'too busy' and 'travelling' provided in the study by Peyrot et al. (9), and also in the domain of 'Forgetting/Delaying and Forgetting' reported by Sullivan (17). The theme of diabetes-related emotional distress in this study and the "stress/emotional problems" category (9) may be capturing a similar patient experience, although it is difficult to know given the absence of any detail about the nature of the stress or emotional problems in the Peyrot et al. study. The theme in this study of 'Adaptive responses to managing blood sugar' may be reflected in Sullivan's (17) 'being in situations where there is limited access to food', and Peyrot et al's 'skipped a meal' (9) both of which might be sensible situations in which to omit insulin as part of self-monitoring (7). The findings reported from the narrative responses of participants in this study are consistent with previous research however, no single study has identified such a range of reasons for insulin omission from a participant perspective in a population with type 1 diabetes. The range and variety of

reasons given for insulin omission by participants in this study reflects the need for interventions aimed at reducing the frequency of insulin omission to be equally diverse, to support those for whom this is a problem.

A further outcome of this study is stage one of the development of an assessment tool, co-produced with patients and clinicians with experiences of diabetes, which provided a measure of insulin omission, insulin restriction, and over dosing. Future development of this measure will involve adjustments based on feedback received from online responders and a larger study validating the measure before introducing it for use in clinical practice.

A potential confounding factor in the study is that the majority of participants were recruited online through support groups, which may make them more likely to identify with their diagnosis of diabetes, and be more motivated to care for their diabetes. Furthermore, women were over-represented compared to men in this sample. This limits the generalizability of the findings to the wider population of those with type 1 diabetes. Finally, the study did not request an objective measure of insulin omission, such as a medical monitoring of blood glucose levels, and so the inferences drawn are based on self-reported data. However, the potential for participants to intentionally misreport this was minimized due to the anonymous methodology.

The current study used both qualitative and narrative findings to investigate the relationship between insulin omission, depression, and self-efficacy. It is hoped that the broader understanding of insulin omission provided can helpfully develop and

inform interventions, and facilitate better communication between patients and clinicians. Further discussion of these results is available in Chapter 6 – Discussion.

The study was approved by the South-West Cornwall & Plymouth Research Ethics Committee

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Chapter 4

Extended Methodology

This chapter will include a description of the ethical considerations for the empirical study and report on the construction and development of the measure of insulin omission.

4.1 Ethical Considerations

Some parts of this section have been minimally changed from the Thesis Proposal for this project (Ames, 2015).

4.1.1. Ethical Approval

Ethical approval for the study was obtained from the Proportionate Review Sub-Committee at South West – Cornwall and Plymouth Research Ethics Committee prior to beginning the study. See approval letter documented in Appendix B which confirms that this was granted.

4.1.2 Consent

Informed consent was taken from participants using Appendices C (patient consent to contact form) and D (consent form) for the questionnaire development, and Appendix E (online consent form) for the online survey. It was not practical to obtain written consent or face-to-face consent for the online survey, given the nature of the project, which was designed to be anonymous.

4.1.3 Confidentiality

For the questionnaire development, a paper consent form was used and signed by participants, which meant that their name was recorded. This information is stored securely in a locked file at the University of East Anglia and has not been recorded electronically. No personal details were taken from participants during the web survey, and so participation was anonymous. Individual responses were stored securely online in accordance with NHS confidentiality policy while the research was on-going. Following this, individual responses are kept securely at the

University of East Anglia and destroyed 10 years after the study has been completed. The account will be kept active until July 2017. The primary researcher (SA) and supervisors (SC and BT) have access to these details.

4.1.4 Participant Safety

The possibility that the survey might elicit distress in some participants was considered, in particular from questions about mood and questions about behaviour that potentially carries a risk to the participants' health. To minimise this, participants were told about the nature of the questions they would be asked before they agreed to take part. Further, participants were informed that they could exit the survey at any point, as well as decline any questions they were not happy to answer. (see Appendices F-H for participant information sheets). When participants finished the survey, or if they chose to exit the survey early, they were directed to a thank you page which contained information about where they could access support (Appendix I). Given the anonymous nature of the study, it was not possible for the authors to contact relevant health professionals about such discoveries, and this was made clear in the participant information sheet.

4.2 Type 1 Diabetes Population

As the current empirical paper describes, differences in insulin omission have been reported between those with type 1 and type 2 diabetes. Peyrot et al. (2010) found that those with type 2 diabetes were more likely to omit insulin than those with type 1 diabetes. Further, differences were reported in the risk factors for insulin omission between these groups, with diet non-adherence being more prominent in type 1 diabetes, and demographic factors such as income, education, and age playing more of a role in those with type 2 diabetes. Despite this, research investigating insulin adherence or omission is sometimes mixed (e.g. Peyrot et al., 2012b, Peyrot

et al., 2012a, Stolpe et al., 2016). This has led to a lack of clarity over whether the results apply equally to both diseases.

A systematic review of insulin adherence measures in those with type 1 and type 2 diabetes revealed a substantial bias towards research in type 2 diabetes (Stolpe et al., 2016). Only two (2.6%) of the 78 studies reviewed were conducted exclusively with people with type 1 diabetes, compared to 58 (74.3%) conducted with people with type 2 diabetes. In order to address this gap, the study aimed to develop knowledge about insulin omission in those with type 1 diabetes.

4.3 Insulin Questionnaire Design

A questionnaire about insulin was developed for the purposes of this study and due to the lack of a specific instrument available to assess this. The main aims of this questionnaire were to identify those who omitted insulin, and to elicit responses from participants in their own words about this. The questionnaire collected quantitative data about the prevalence and frequency of insulin omission in adults with type 1 diabetes, surveyed online. Other aspects of adherence to insulin medication, such as taking less or more insulin than required, and the frequencies of these were also assessed, as well as information about links with mood.

4.3.1 Self-report Questionnaire Design

The measure was designed following the current systematic review of existing measures of insulin adherence in previous studies. A self-report method was selected following the review which revealed self-report measures were the most frequently used measurement of insulin adherence, and may be favorable in terms of ease of use for both patient and clinician when compared to medical monitoring or interview methods (Stirratt et al., 2015). Additionally, questionnaires were the form of self-report that correlated most highly with other measures of adherence, such as

clinical opinion, claims data, and drug levels (Garber, Nau, Erickson, Aikens, & Lawrence, 2004). Shi et al. (2010), in an investigation of the differences between self-report and medical monitoring in measuring adherence, found that the majority of self-report questionnaires showed high or moderate correlation with medical monitoring devices, and recommended considering patient report as a method of measuring adherence. Finally this form of assessment was most suitable for an online survey. This follows advice from Clifford et al. (2014) to select a methodology for measuring adherence to diabetes medication that best fits the research question, study design, population, and resources.

It was identified in existing literature that previous measures of insulin omission or adherence did not allow participants scope to explain their reasons for either omission or non-adherence. This meant that an opportunity to collect potentially important clinical data, which may be beneficial for designing interventions to target insulin omission, or insulin adherence more generally, was missed.

Finally, it was observed by the researchers that the language used in some self-report measures of insulin adherence may have the potential to feel stigmatizing or judgmental for patients with diabetes, for example asking participants if they are 'negligent' (Gomes & Negrato, 2016). Adaptation of these questionnaires was therefore considered necessary.

4.3.2 Open-ended Question Design

Peyrot et al. (2012a) developed a questionnaire that aimed to investigate reasons for insulin omission and non-adherence, (measured by asking participants whether they ever miss a dose or take it not exactly as prescribed) via computer assisted telephone interviewing. The questionnaire suggested possible reasons from a

list that participants could then choose from. However, no information was available to indicate the basis upon which these questions were initially selected. Likewise, Farsaei et al. (2014) reported a list of possible barriers to insulin omission, including for example age, gender, embarrassment, cost, weight gain, and forgetfulness, with no information about how these reasons had been devised, including whether they had been generated by participants, existing research, or the researchers. It is therefore unclear how appropriate or inclusive these pre-selected responses were for those with type 1 diabetes as explanations for insulin omission. Further, it is possible that suggesting reasons using pre-selected criteria (closed questions) may cue respondents into thinking of particular reasons, as discussed by Roberts et al., (2014). This was inconsistent with the aims of the study, which intended to elicit from participants their reasons for insulin omission.

4.3.4 Anonymous Methods of Data Collection

The difficulties of closed questions can be addressed by utilizing more open interview methods, as used by Sullivan (2012). However, participants recruited in the Sullivan study using interview methods did not report any association with mood, and also did not report using insulin as a way to control their weight or shape, which has commonly been identified in previous literature (e.g. Trief et al., 2014; Polonsky et al., 1994). This discrepancy in findings about the role of mood and weight control in insulin omission supports previous evidence that different methodologies may produce different levels of disclosure (Lucas, Gratch, King, & Morency, 2014). One of the reasons for this is thought to be confidentiality, with Singer, Mathiowetz, and Couper, (1993) finding that concerns about confidentiality and privacy significantly influenced mail returns on a census. Participants may fear that their responses will be disclosed to agencies not directly involved in the

research, the reality of which is often made explicit in health research, as contact details of a medical professional with responsibility for the participant's care can be requested. Further, concerns about being judged negatively by the researcher may mean that participants do not provide honest, detailed information (Farber, 2006). A meta-analysis by Weisband and Kiesler (1996) found that using computer administered assessment methods was associated with increased disclosure of personal information. They found that these effect sizes were largest when comparing computer administration with face-to-face interviews, when participants were medical or psychiatric patients, and when the information was sensitive. A more recent study by Lucas et al. (2014) also found that when an interview process was seen as virtual, or as conducted by a computer, participants reported a lower fear of self-disclosure, low impression management, displayed sadness more intensely, and were rated as more willing to disclose. To the researcher's knowledge, no questionnaire to date has allowed participants the scope to freely and anonymously write about their reasons for insulin omission.

This study aimed to address these measurement issues by designing a questionnaire that was acceptable to patients, measured the prevalence and frequency of insulin omission, and collected data about the reasons patients might engage in insulin omission to facilitate the development of our understanding of this area. Although the primary purpose of this questionnaire was to obtain information about insulin omission in response to specific research questions, the researchers held in mind that in the future it may also be a useful tool, if modified, for clinicians to use when assessing whether their patients omit insulin, and to understand why.

4.4 Insulin Questionnaire Development

4.4.1 Questionnaire Development Stage One

The initial stage of this process involved collating information from measures that had been used in previous studies. This included material developed from the limited research available reporting assessing insulin omission such as the questions used by Peyrot et al. (2010; 2012b; 2012a), Trief et al., (2014) and Polonsky et al. (1994). The questions from the Morisky Medication Adherence Scale (1986) were also considered and parts of this questionnaire adapted, as this is a validated and often used method of measuring medication adherence by self-report, including in studies of type 1 diabetes (Gomes & Negrato, 2016; Stolpe et al., 2016), although as discussed in the current systematic review, there are some disadvantages of these instruments including the language used, and a lack of opportunity to explain the reasons for adherence or non-adherence. Additionally, the Morisky Medication Adherence Scale was found to have low sensitivity in a diabetes population by Sakthong, Chabunthom, and Charoenvisuthiwongs (2009). From these sources and following adaptation, the first draft of a questionnaire was produced that focused on asking questions about insulin omission and under-dosing (see Appendix J). Questions were phrased first asking about whether participants ever omit insulin, e.g. ‘Do you ever skip (miss out) an insulin dose that you know you should take’, followed by four follow up questions about frequency, requesting information on the number of days, and the number of times over the last seven and 28 days respectively. There was also a space for participants to provide an answer in response to the prompt ‘please explain in your own words why you skipped an insulin dose that you knew you should take’. This format was repeated for questions on whether participants took less insulin than they should, and whether they forgot to

take their insulin. Participants were asked to comment on whether their mood ever affected how they took their insulin, and the circumstances under which they would be more and less likely to take insulin as they should.

4.4.2 Stage Two – Consultation

Previous health research has highlighted the value of including clinicians and patients in the development of a new measure (Van der Molen et al., 2003). It is argued that by involving both clinicians and patients at this stage, it allows for the representation of items that are relevant to both parties. Leung (2001) also argues that the piloting of questionnaires with people characteristic of those the questionnaire is for, is a crucial step in any measure development. Therefore, the second stage of this process involved consultations with a multi-disciplinary clinical diabetes team working from a diabetes clinic and with patients presenting at the clinic with type 1 diabetes. Consultation with the diabetes team took the form of a presentation that was attended by approximately 20 diabetes specialist clinicians, including consultants, junior doctors, specialist nurses, and a specialist clinical psychologist. The presentation outlined the research project and included a copy of the questionnaire which was given to each attendee for their comments and suggestions. Feedback on the scope, form, and content of the questions was requested and provided by the team members.

On the same day, individual feedback was requested from a participant with type 1 diabetes who attended the hospital, and a professional with type 1 diabetes who worked at the diabetes clinic. Both were directed to the consultation stage of the study by the clinical psychologist in the team as individuals who may be interested in contributing to this research. It was hoped that more participants with type 1 diabetes would be identified to take part in this development phase of the study, and

the diabetes team were encouraged to provide the participant information sheet and consent to contact form to any patients who may be interested in order to facilitate this. However only two participants with type 1 diabetes came forward within the necessary time-scale and were included. The participants were initially given information sheets and time to decide whether they wished to take part, and filled out a consent-to-contact form. It was then arranged by email that the primary researcher (SA) would meet these participants to obtain feedback on the questionnaires. Written consent to take part in the consultation stage of the study was given at the start of the meeting.

4.4.3 Feedback from Staff Team Consultation. Following the presentation, the staff team reported with consensus that the questionnaire would benefit from less focus on the quantity of insulin doses missed. They reported that the volume of questions about this in the original questionnaire could potentially feel judgmental or punitive and therefore off-putting to participants. As an alternative, they suggested listing frequencies and requesting that participants select a range from a list, rather than being required to remember exactly how many insulin doses they had missed. Additionally, clinicians reported that a one-month time scale was likely to be too long for participants to recall how many insulin doses they had missed, and that a week might be more appropriate. It was also suggested that a validating sentence at the start, making reference to the fact that many people miss injections and for a variety of reasons, may promote more honest reporting and potentially reduce an element of shame. Remaining sections of the questionnaire were deemed to be straightforward and clearly accessible to participants.

Feedback was provided which suggested that if the tool were to be used in clinical practice, it would be helpful for clinicians to know which insulin doses were

missed by patients or participants, as missing long acting insulin or short acting insulin is likely to lead to different clinical outcomes.

It was thought that, in the question about participants taking less insulin than they need, this could be expanded to also capture data about when participants take more insulin than they need. The clinicians reported that this is something that can also cause complications, that they sometimes experience with their patients, which it would be useful area to gather information on.

The diabetes team were also interested to know whether people who omit insulin would discuss this with their clinicians. Capturing this data anonymously in the first instance provided an opportunity to give this and other diabetes teams a sense of whether their patients feel able to share this information, or ask for their help.

Overall, the team felt that it was important for the questionnaire to ask fewer questions about frequency, and more questions about the reasons people engage in this behaviour. Given that a number of studies have reported diabetes medication adherence frequencies (e.g. reviewed by Clifford et al 2014; Krass, Schieback, & Dhipayom, 2015; Cramer, 2004, and also reported by the current systematic review) the recommendations from the feedback were implemented. In common with clinician reporting, a review of the available literature revealed that there was less empirical information available about why people omit insulin (Peyrot et al., 2012b), and none to the authors' knowledge that has given participants the opportunity to comment on this freely and anonymously without providing pre-defined response options.

4.4.4 Feedback from Participants with Type 1 Diabetes.

From the individual interviews with participants with type 1 diabetes, further feedback was obtained on this initial questionnaire. As part of the process, changes that had been suggested by the diabetes team were explained, and feedback was requested on these. In general, there was an agreement about proposed changes, and no proposed changes were objected to. These participants also suggested that it was important to ask about gender, and it was suggested that men may be worse at contacting the diabetes team for help. This suggestion was supported by the literature, with a review by Galdas, Cheater, and Marshall (2005) revealing that men are more likely to delay seeking help for health problems when they become ill. It was also suggested that the timing may be important, as participants may be likely to miss injections at the same time each day, such as lunch time, for example if they are more likely to be out or at work, and therefore busy or distracted, or in the evening if they feel too tired to take insulin. Both participants suggested independently that the proposed question about mood needed to be asked in both directions, stating that as well as their mood affecting whether they take insulin, taking insulin can also have an effect on their mood.

Feedback on the wording used was also provided, for example instead of ‘please explain’ it was suggested that ‘could you’ or ‘are you able to’, might feel less directive for participants. It was also suggested by the diabetes professional who had type 1 diabetes that asking ‘what would motivate you to take your insulin as you should’ might be a method of collecting data that is important for researchers in order to guide interventions, and also important for clinicians to understand what might help their patients.

4.4.5 Stage Three - Revision

The questionnaire was substantially adapted based on this feedback. The multiple frequency questions were taken out, and replaced with frequency ranges for two behaviours: ‘Do you ever skip (miss out) insulin doses that you know you should take?’ and ‘do you ever take more or less insulin that you know you should?’. Follow up questions included ‘If yes, in the last 7 days was this: less than two times, 2-4 times, 4-6 times, 7 times or more’, and ‘If yes, could you explain in your own words why you skipped an insulin dose that you knew you should take?’ Additional questions were included about the timing of skipped doses, the type of dose, and whether this was perceived as a problem for the participant. Further questions on whether participants informed their diabetes team that they were missing insulin doses, and open-ended questions about links with mood were included. Questions on what makes participants more or less likely to take insulin as they should, and what would motivate them to take insulin as they should were also included in the revised version of the questionnaire. The final question in the online survey requested feedback on the insulin questionnaire, to facilitate further development of the measure.

4.4.6 Stage Four – Feedback Requested on Changes Made

A revised version of the questionnaire including the changes made on the basis of feedback was sent to the diabetes team highlighting where these changes had been made. In response to this, an email was received which gave a suggestion for an introduction to the questionnaire ‘Living with diabetes is hard work, practically, physically and psychologically. Research tells us that many people miss insulin doses sometimes. This questionnaire aims to help us understand why.’

4.4.7 Stage Five – Final Version

This sentence was added, and the resulting questionnaire was used in the online survey. See Appendix K.

4.5 Treatment of Qualitative Data on Insulin Omission.

Careful consideration was given to the selection of a method used for analysing the data collected from open-ended questions included in the questionnaire. The options explored included thematic analysis using the framework provided by Braun and Clarke (2006), Grounded Theory (Strauss & Corbin, 1990) and Interpretative Phenomenological Analysis (IPA; Smith, Flowers, & Larkin, 2009). Grounded theory aims to construct a theory through the analysis of data, which was not thought to be relevant to the research aims of the current study. IPA is an approach which aims to provide a detailed examination of personal lived experience, and is tied to a phenomenological position. Given the potential for high frequency short answers, this did not seem appropriate for the methodology used in this study. The potential future use of the questionnaire as a clinical tool was considered, and it was thought that identifying common themes in the answers might allow for these to be included as questions or options for a closed-question questionnaire in the future. Additionally, the identification of themes would allow for a comparison with the categories or options given, or constructs identified in previous studies, such as Sullivan (2012) and Peyrot et al. (2012). A thematic analysis also offered the advantages of being a theoretically flexible approach, meaning that it would not be tied to a particular theory or epistemology. This meant that it could be applied across a range of theoretical approaches. On this basis, a thematic analysis using Braun and Clarke's (2006) framework was selected for use in this study.

An inductive analysis style was used, meaning that the themes identified were strongly linked to the data in a 'bottom up' way, rather than in a 'top down' more theoretical and deductive way. Themes were identified at a semantic level, meaning that the researcher focused on the surface meaning of what was written rather than attempting to explore deeper meanings. The author took an essentialist approach (Braisby, Franks, & Hampton, 1996), which complements the inductive analysis. This approach assumes that it is possible to create theories about meaning from language, because of the view that language is a tool which reflects and enables us to communicate meaning and experience. Some engagement with the literature had taken place prior to analysis in order to identify research questions and the gap in the literature that the current project aims to fill.

The research software NVivo 11 (QSR International Pty Ltd, 2016) was used to aid the thematic analysis. This was used to organise, group, and code themes together.

The six steps recommended by Braun and Clarke in their paper 'Using thematic analysis in psychology' (2006) were followed. This involved first becoming familiar with the data through repeated reading and searching for patterns. Data were read and reread for any themes that occurred in response to questions 'can you explain in your own words why you skipped an insulin dose that you knew you should take?', as well as looking at the answers of those who reported why they sometimes take less insulin than they should. Secondly, initial codes were generated. This involved identifying multiple potential themes, and only leaving ambiguous data un-coded. This ensured that the analysis did not move away from the semantic or surface level meaning of the data. Some of the extracts were coded into more than one initial theme. The codes were organized around the frequency of their

occurrence in the data, and were not linked to previously found themes or the authors' particular interests in the topic. Phase three involved searching for themes within the codes. At this point, different codes were combined in order to form an over-arching theme, for example 'being too busy' and 'being distracted' were coded into the broader theme of 'lifestyle', as led by the data, while other potential themes were discarded. A visual map was created in order to do this (see Appendix L). Phase four involved reviewing the themes, reading all the extracts for a particular theme, and ensuring that a pattern was present. In phase five the themes were named and defined. This was done with the intention of the name immediately informing the reader what is captured by the theme. Phase six involved writing up the themes, including extracts of participants' answers.

4.6 Researcher Position

The importance of making explicit the position and background of the researcher in qualitative research is outlined by Berger (2015). It is argued that the character and experiences of the researcher may impact upon their reflexivity, which is a strategy for quality control in qualitative research. I am a white British female in my late twenties. I have designed and undertaken this research project as part of a Doctoral Programme in Clinical Psychology at the University of East Anglia. My epistemological position centers around constructivism, I believe that knowledge is constructed through experiences, rather than being an objective reality (Raskin, 2002). I have a professional interest in Clinical Health Psychology, and had no personal or professional experience of diabetes before starting this project. I was drawn to the project because of the opportunity to explore the interplay between mental and physical health. I hoped to understand patterns, associations, and reasons

for insulin omission, and to be able to share this knowledge in a way that would be helpful for patients and clinicians.

Chapter Five

Extended Results

This chapter provides further detail on the results reported in the empirical study, and reports additional results not included in the empirical paper due to the constraints of the word limit of the selected journal.

5.1 Data Preparation and Cleaning

5.1.1 Parametric Assumptions

Quantitative data were screened to determine whether parametric testing was appropriate. Kolmogorov-Smirnov tests and Shapiro-Wilk tests were conducted in order to identify whether the data were normally distributed in the insulin omission and non-insulin omission groups. Results were significant for all cases except for diabetes specific self-efficacy in the insulin omission group. However, Field (2009) states that for large sample sizes, the power of these tests increases, and they are likely to be significant when distributions are only slightly different from normal. He suggests that in these cases, the skewness and kurtosis statistic be taken into account. The further the statistic is from zero, the less normal the distribution is. Brown (2016) reports that anything above +1 or below -1 is considered to be highly skewed. Therefore, for the measures used in statistical analysis, the skewness and kurtosis statistics were initially calculated. If these values were either above +1, or below -1, they were considered as not normally distributed, and therefore were not tested using parametric statistical tests (which require the assumption that data are normally distributed).

Another assumption of parametric testing between groups is homogeneity of variance. Data for group comparisons were therefore also tested using Levene's test (see Table 5.1).

Other assumptions of parametric testing include data being interval or ratio,

and scores being independent. These assumptions were considered to be upheld by the data based on the questionnaires using scale measurement, and the study design meaning scores were independent.

Table 5.1 *Parametric testing of study variables used for comparing means*

	Kolomogorov- Smirnov Sig.	Shapiro- Wilk Sig.	Skewness Statistic	Kurtosis Statistic	Levene's Sig.
Depression (no omission)	.001***	.001***	0.92	-0.18	.008**
Depression (insulin omission)	.009**	.002**	0.43	-1.02	
General self-efficacy (no omission)	.001***	.001***	-0.35	0.26	.03**
General self-efficacy (insulin omission)	.001***	.003**	-0.75	0.06	
Diabetes specific self-efficacy (no omission)	.008**	.001***	--0.73	1.17	.09
Diabetes specific self-efficacy (insulin omission)	.20	.24	-0.28	-0.39	
Diabetes self-management (no omission)	.001***	.001***	-0.71	0.20	.001***
Diabetes self-management (insulin omission)	.03*	.03*	-0.31	-0.96	
Health care use (no omission)	.001***	.001***	-2.16	5.12	.001***

omission)					
Health care use (insulin omission)	.001***	.001***	-0.83	-0.46	
Physical activity (no omission)	.001***	.001***	-0.59	-0.38	.65
Physical activity (insulin omission)	.008**	.006**	-0.48	-0.32	
Dietary control (no omission)	.001***	.005**	-0.27	-0.24	.06
Dietary control (insulin omission)	.002**	.002**	0.67	-0.31	
Glucose control (no omission)	.001***	.001***	-1.44	2.33	.001***
Glucose control (insulin omission)	.01**	.003**	-0.06	-1.31	
<i>Note:</i> * $p < .05$, ** $p < .01$, *** $p < .001$					

As suggested by Field (2009), variables which did not meet the assumption of normality, which included depression, diabetes specific self-efficacy, health care use, and glucose control from Table 5.1 were analysed using the Mann-Whitney test. This is a non-parametric alternative to the t-test, and analyses ranked positions of scores in different groups.

When Levene's test was significant, providing that the data had not violated the assumption of normality, the t – test statistic was used which did not assume homogeneity of variance between the two groups (Field, 2009). This was the case for general self-efficacy and diabetes self-management. If assumptions of normality

were violated, non-parametric tests were used regardless of the significance of Levene's test. This was important given Cribbie, Fikensenbaum, Keselman, and Wilcox's (2012) paper which describes that one-way independent group designs have increased type I error and reduced power when data is not normally distributed.

Table 5.2 *Parametric testing of study variables used for correlation analysis.*

	Kolomogorov- Smirnov Sig.	Shapiro- Wilk Sig.	Skewness statistic	Kurtosis statistic
Depression	<.001**	<.001**	0.84	-0.32
General self-efficacy	<.001**	<.001**	-.60	0.62
Diabetes specific self- efficacy	.002*	<.001**	-0.61	0.30
Diabetes self- management	<.001**	<.001**	-1.04	.71

Note: * $p < .01$, ** $p < .001$

Table 5.2 demonstrates that only diabetes self-management has a Skewness of more than +1 or less than -1. Therefore, as recommended by Field (2009), Kendal's tau was used for correlations with diabetes self-management. This test was selected over Spearman's correlation due to suggestions that Kendall's statistic is a better estimate of the correlation of the population (Howell, 2012). Pearson's correlations were used between the remaining variables, as the parametric assumptions were considered to be intact (data were interval, scores were independent, and homogeneity of variance was not required).

Insulin Questionnaire Results

5.2 Multiple Choice Answers from Insulin Questionnaire

5.2.1 Discussing Insulin Omission with the Diabetes Team

Overall, 44.4% of the 171 participants who responded to a multiple-choice question said that they would not speak to their diabetes team if they were missing insulin doses. This rose to 51.7% when only including those who reported omitting insulin. Of those who reported omitting insulin, 69.0% stated that this was a problem for them. This meant that 18 participants (7.8% of sample) reported that omitting insulin doses was a problem for them, and also said that they wouldn't talk to their diabetes team about this.

As well as answering this multiple-choice question, two participants commented directly on this issue in the overall feedback section of the questionnaire. One participant wrote:

It's interesting to be asked these questions as I'm not really honest when it comes to speaking to my diabetes team, I feel they can be too judgmental sometimes so I make out I'm doing better than I probably am. A lot of it is remembering to take the insulin. I work a busy day so I do have a habit of forgetting. Sometime I do not see the true importance of skipping a dose, think I can make up for it on the next one.

Another participant commented:

I think this is more common than the team know. It does affect my mood and I am aware of the damage I can do by reducing insulin but you never think it'll happen to you. I have no complications from my diabetes, yet.

Differences in responses to speaking to the diabetes team between men and women were also assessed, as during the questionnaire development consultation

stage it was suggested that men may be worse at reporting insulin omission than women. Results showed that 32.4% of the 37 men who responded would not tell their diabetes team if they were missing insulin doses, which rose to 40.0% when only considering the answers of the ten who reported omitting insulin. By comparison, 47.8% of the 134 women who responded reported that they would not tell their diabetes team if they were missing insulin doses, rising to 54.0% when only considering the answers of the 50 who reported omitting insulin. Based on the information provided, in this sample men were more likely than women to tell their diabetes team if they were missing insulin doses.

5.2.2 Characteristics of Insulin Doses Missed

Of the 75 participants who responded to the question, “Is there a particular dose of insulin you are likely to skip? If yes, which one?” 12.0% responded saying their long acting dose, and 18.7% responded saying their short acting dose. The remaining answers either said “no” or did not specify a dose.

A total of 94 participants responded to the question “Is there a time of day when you would be more likely to skip an insulin dose? If so, when?”. Of these, 17.0% wrote the morning, 14.9% reported lunchtime, 7.4% reported snacks during the day, 18.1% reported in the evening, and 10.7% reported before bed. The remaining answers either said “no”, or spoke about missing doses without providing a time of day. Based on these results, the evening was the time of day when the highest number participants would be most likely to skip insulin doses.

5.3 Narrative Data Results

A total of 123 of the 231 respondents to the survey (53.2%) provided a response to one or more of the open-ended questions inviting further comments.

5.3.1 Insulin Omission

In total 57 of the 60 respondents (95.0%) who reported insulin omission in the last seven days also provided a comment about why. These were analysed using the six-stage process outlined by Braun and Clarke (2006). Over 90% of these comments were encompassed in the following five themes: a) Prioritising: Forgetting and the demands of daily lifestyle, b) Diabetes related emotional distress c) Weight control, d) Avoidance: Fear of physical effects, and d) Adaptive responses to managing blood sugar levels. Themes were initially coded using only comments given in response to the question ‘could you explain in your own words why you skipped an insulin dose you knew you should take’. This was to ensure a focus on the research question ‘*What are some of the reasons that people omit insulin?*’ within the final themes reported. Once the themes had been established, they were considered in the context of all responses provided, and comments from other areas of the questionnaire that were thought to be representative of one of the five themes were also included in the analysis. This allowed for a greater depth of understanding, for example when evaluating the theme of diabetes related emotional distress, additional insight was gained from considering responses to the question: ‘Does taking insulin effect your mood? If so, how?’ Additionally, considering the themes relating to omission in the context of all the data provided allowed differences and similarities between those who reported insulin omission, those who reported insulin restriction, and those who reported taking more insulin than they knew they should to be explored. Illustrative quotes are provided in Table 5.3.

a) Prioritising: Forgetting and the demands of daily lifestyle (56.5%). The most commonly reported reasons for insulin omission were represented by this theme, with over 56% of the response codes being encapsulated here. Although

respondents reported a variety of lifestyle factors as reasons for insulin omission, such as parenting responsibilities, being unable to take a break at work, or being distracted from their routine, the idea that taking insulin was difficult to prioritize was implicit or explicit in each. Included in this theme were participants who reported that they forgot to take their insulin, without elaborating further or offering a reason for this (15.3%). Although not made explicit in the responses, it is suggested that some or all of these forgetting responses are related to lifestyle factors and priorities described above. This is based on the finding that the respondents who wrote additional information when they reported forgetting also wrote about such factors by way of explanation. This theme did not present as a reason for taking more or less insulin, as no participants who commented about taking more or less insulin provided answers that fitted this general premise.

b) Diabetes related emotional distress (14.5%). A variety of negative emotional responses to insulin or to diabetes, such as resentment, frustration, and a sense of hopelessness, were cited as primary reasons for omission by nine respondents. Some participants described a sense of hopelessness, feeling that regardless of their efforts they would not be successful in managing their blood sugar, while others described using insulin omission to actively take control, such as to choosing to continue like a ‘normal non-diabetic person’ or ‘to be in control of my body’. When responding to the additional questions about the impact of taking insulin on mood, many participants commented that they feel frustrated and fed up with taking insulin, and that taking it can leave them feeling sad, angry, or embarrassed. Distress of this nature was not reported as a reason for taking more or less insulin by any participants, with the exception of one participant who reported once taking excess insulin as an attempt to end their life.

c) Weight control (12.9.%). The complex relationship between insulin and weight was provided as a reason for insulin omission. Participants wrote about deliberate insulin omission leading to desired weight loss, with some describing the process of how this happens, reporting that omission resulted in sugar and calories being purged rather than absorbed. Respondents also reported that the experience of taking insulin can lead to weight gain, and named insulin omission as a method of avoiding weight gain, rather than for the purpose of weight loss per se. Individuals reported that that they felt they were 'too fat', that they felt 'guilty' after eating, that they were fearful of weight gain, and described insulin omission as an opportunity to act on this, with rapid results being achieved. Of note, is that as well as 12.9% of those who gave a reason for insulin omission reporting reasons relating to weight control, 16.7% of those who gave a reason for insulin restriction also mentioned weight loss or weight management. The link between insulin omission / restriction and weight control may be indicative of eating disorder psychopathology in these cases.

d) Avoidance: Fear of physical effects (9.7%). This category comprised of an avoidance that was reported as being fear based, including fear of the symptoms of hypoglycemia and anxiety about injections or pain. Participants mentioned in particular a fear of hypoglycemia when alone, in situations such as driving, doing 'important tasks', at night, or in public. This theme was identified in some answers about taking more insulin than required also. Two respondents who reported taking more insulin than they should state that they did this out of fear of their blood sugars levels being high. These participants commented on their fear of the long-term complications of high blood sugar, and the implications for their health and family life. Fear of the physical effects was reported as the primary reason for insulin

omission in 9.7% of those who reported insulin omission, and as a reason for taking less or more insulin in 26.4% of cases.

e) Adaptive responses to managing blood sugar levels (6.5%). The long-term management of diabetes requires individuals to be responsive to their blood sugar levels and to use insulin, or not do, accordingly. Measuring or anticipating low blood sugar, and taking steps to correct this, was reported as a reason for insulin omission by 6.5% of respondents. Participants wrote about experiencing low blood sugar through exercise or lack of food, or when they have missed previous doses, and attempting to manage this through omitting insulin, which if taken would be likely to lower their blood sugar even further. Although some reported that this was a mistake in retrospect, the sense captured by this theme was of the participants' intention to respond adaptively to a situation where missing an insulin dose might be sensible. Of note, of those who reported reasons for restricting insulin and/or taking more insulin than they knew they should, 46.3% of respondents reported reasons which appeared to be an attempt to adaptively and safely manage their blood sugar. Examples include taking less insulin before exercise, when blood sugars are effected by stress or temperature, or following an episode of hypoglycemia, and taking more insulin when blood sugars have been higher, or when planning to consume more food. Many of these participants reported not trusting the recommended dose due to feeling that from their experience it would not accurately manage their blood sugar, and so adjusting it as they deemed necessary.

Table 5.3 *Illustrative quotes of reasons for insulin omission by theme.*

Theme	Representative quotations
a) Prioritising: Forgetting and the demands of daily lifestyle	<p>‘Occasionally I am so tired. By the time I go to bed I cannot manage to take my injections and meds. Typically I sleep for a few hours and then wake up and administer, but sometimes I sleep through.’</p> <p>‘Would be distracted by my lad - am a single parent and only realised I missed it when felt awful later.’</p> <p>‘Unplanned eating or eating nasty party food, or if the office provides a buffet lunch.’</p> <p>‘Not skipped on purpose. Lead a busy lifestyle.’</p> <p>‘Usually my night time levemir because I have been too tired and fell asleep before I should of taken it.’</p> <p>‘Laziness.’</p> <p>‘I felt it was too much trouble to re-site my pump cannula.’</p> <p>‘Didn't skip but when entertaining or serving a big family meal I sometimes put it off until everyone is served then forget.’</p> <p>‘In a rush or pre-occupied with other task so forgot to take the shot.’</p> <p>‘Forgetting, not being able to remember. Task is so repetitive on any given day I can't know for sure if I have done it or not.’</p> <p>‘Just forgot.’</p> <p>‘I think I can correct it later, and then sometimes forget.’</p>
b) Diabetes related emotional distress	<p>‘Rather than check bloods and take insulin I prefer to ignore it, block it out and continue like a normal non-diabetic person.’</p> <p>‘I felt almost hopeless, as if dosing still wouldn't result in good outcomes.’</p> <p>‘Sometimes I just want to forget I have diabetes, sometimes I am just fed up of injecting as I have already done it 4 times in 1 day.’</p> <p>‘To be in control of my own body.’</p> <p>‘Sometimes I forget or are so damn sick of my disease that I don't want to.’</p> <p>‘Most of the time it's because I feel so down about my poor control that I don't see the point in trying.’</p> <p>‘If I'm feeling low moods sometimes I don't bother and ‘punish’ myself by not taking it.’</p> <p>‘I'm just fed up with diabetes. Even if I do everything right, it is</p>

	<p>never the same, so you feel you're always doing it wrong.'</p> <p>'Sometimes I get so angry about having type 1 diabetes.'</p>
c) Weight control	<p>'To lower my weight, I have gained a stone and I know as a quick fix, running my sugars high will give me a quick weight loss.'</p> <p>'I was having good results but kept dipping and hypo-ing. In a short time I gain weight. This made me feel uncomfortable and fat so I reduced my insulin intake on my phone Pod to lose weight quickly.'</p> <p>'I know it helps reduce weight by allowing ska to begin.'</p> <p>'Cannot stand the thought of the weight gain from my binges.'</p> <p>'I've taken less when I've eaten too much food and drunk water so that I can flush out the sugar and kcal's instead of absorbing them and taking the insulin which can lead to weight gain.'</p> <p>'In order to reduce current weight and/or to avoid the possibility of putting on weight on with increased insulin doses.'</p>
d) Avoidance: Fear of physical effects.	<p>'Anxiety over injections.'</p> <p>'Was worried I took a hypo and nobody would be there to help even though I know deep down I can help myself with hypos.'</p> <p>'Scared of hypo's when on my own, so will not take the full dose of insulin required for meal or have small snacks without insulin if I'm going to be on my own.'</p> <p>'Scared of running hypo in public.'</p> <p>'I have pdr in both eyes & have undergone 3 operations to save my sight. It is my biggest fear to not be able to see again, to never see my children grow up. As I know high blood sugars can contribute to poor eye health I have a 'fear' of any blood sugar over 7 mmol. I tend to overcompensate for any slightly higher blood sugars on a regular basis despite knowing it will lead to a hypo, I just cannot bear to see any reading above 7.' (reason given for taking more insulin)</p>
e) Adaptive responses to managing blood sugar levels	<p>'Towards the end of the day. If I have not eaten that much in a day I think that my sugar levels will be low enough that I don't need additional insulin to cope with the food intake.'</p> <p>'I had low blood sugar and I wanted to avoid an hypoglycemia.'</p> <p>'Did not feel like eating.'</p> <p>'Because I always drop low during the night if my levels are under a certain number at night, despite not even taking insulin.'</p>

‘I often take less insulin than I should because I am a very active person and I’m aware that I will probably have up to 2-3 hypos if I have either the "correct" amount or over the amount.’

*These quotations have been minimally changed for the purposes of clarity and to preserve anonymity.

** Some responses are taken from other areas of the questionnaire if representative of the theme.

These findings reflect the variety of reasons that people with type 1 diabetes might omit their insulin medication, and are presented visually in a thematic map in Appendix L.

5.2.2 Associations with Mood

In relation to mood, participants were asked ‘does your mood affect how you take insulin?’ and ‘does taking insulin affect your mood?’ Around one third (36.0%) of all those who responded, and two thirds (60.0%) of those who omitted insulin reported that their mood affects how they take insulin. Additionally, 32.0% of all those who responded, and 43.3% of those who omitted insulin reported that taking insulin affects their mood. Further 19.6% of all those who responded, and 28.3% of those who omitted insulin reported both that their mood affected how they took insulin, and that insulin affected their mood. Commonly reported responses about the impact of mood on taking insulin were apathy – with reports from participants describing that they could not be bothered to check their blood sugar or to take insulin, and not caring about the consequences, as well as feeling fed up with taking insulin, and responding to stress by taking more or less insulin. Participants also explained the way that insulin can affect their mood, with many patients who responded to this question explaining a negative effect. This included feeling annoyed about needing to take it, feeling sad or angry, or feeling bad about the size of the dose, and the fact that lower blood sugar also lowered mood. Some respondents reported that taking insulin made them feel better by managing their

high blood sugar and the physical impact of this and associated stress. Examples are reported in Table 5.4

Table 5.4 *Illustrative quotes for the relationship between mood and insulin omission*

Question	Representative quotations
Does your mood affect how you take insulin?	<p>‘If I’m feeling down or sad, I don’t take it because I don’t care what will happen.’</p> <p>‘I’m just fed up with diabetes. Even if I do everything right, it is never the same, so you feel you’re always doing it wrong. When I’m depressed, I feel even less inclined to take care of myself. It’s too unpredictable, and I need a break.’</p> <p>‘If I’m depressed I can’t be bothered with my diabetes.’</p> <p>‘Low mood means I’m likely to sleep more, and binge eat when I’m awake but not necessarily take my insulin.’</p> <p>‘Sometimes when I’m feeling anxious or depressed and out of control I tend to restrict my insulin.’</p> <p>‘If I feel anxious I eat more than usual, which results in too little insulin even though I take the normal dose. If I’m having a bad day and feeling angry, I take more than normal which causes my blood sugar to fall very fast.’</p> <p>‘if I’m feeling good then I’m more likely to care and control my levels.’</p> <p>‘If I’m stressed at having a very high blood glucose reading then I will deliberately overdose on quick acting.’</p>
Does taking insulin affect your mood?	<p>‘It ruins every mealtime, having to think about how much insulin to take every time. Life has lost its spontaneity. Other people also think about it, and I hate burdening other people with my issues.’</p> <p>‘Get really frustrated and annoyed sometimes that it’s necessary to take it, just generally fed up that I can’t ever just eat without thinking about consequences of taking or not taking.’</p> <p>‘It does. I find a lot of non-diabetics are very judgmental about me injecting in public or eating things that are not classed as ‘good’ for a type 1 on insulin, despite my dietician explaining about having a balanced diet’</p> <p>‘Yes if my blood sugars are high i can be tired and short tempered, once I’ve taken the insulin I generally feel more energetic and awake.’</p> <p>‘Sometimes it can relieve stress - if I am worried about a very high BG reading then it calms me down to know I have acted to bring the levels back down.’</p> <p>‘Too much insulin makes me hyperactive and silly. Too little insulin causes me to be in a bad mood and irritable with zero tolerance for others.’</p>

5.2.3 Motivation to Adhere to Insulin Regime

In total, 123 (53.2%) of all participants provided a written response to the question ‘What makes you more likely to take insulin as you should?’. Additionally, 116 (50.2%) of all participants provided a written response to the question ‘What would motivate you to take your insulin as you should?’. Answers were grouped together based on similar topics or words, and reflected a variety of factors reported by participants that might motivate them as individuals to take insulin as they should. A commonly reported response stated by individuals was that the achievement of better results would be motivating for them. Participants commented that certainty about hypoglycemia or perfection in blood sugar levels would, or does, help them take their insulin as they should. Further, participants wrote about their long-term health, reporting that they were motivated to prevent complications in the future. Another commonly reported response was support and acceptance. Participants wrote about the way that being accepted by both strangers and those close to them, and supported by those around them including professionals involved in their care would or does help them.

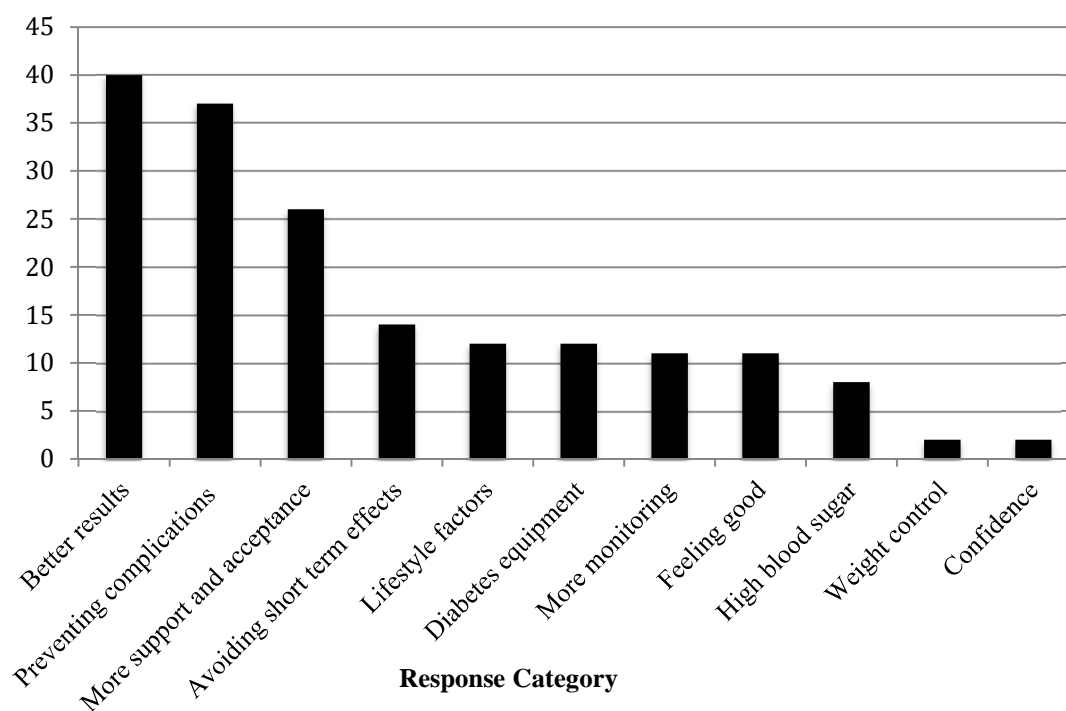
Other less frequently reported factors included feeling better in the short-term after taking insulin appropriately, more monitoring, lifestyle factors, mood, weight, confidence, and being motivated by experiencing high blood sugar. Of note, despite eight participants who omitted insulin quoting weight loss as a reason for insulin omission, only two said that weight loss/ less weight gain would motivate them to improve. Categories and examples are reported in Table 5.5. Frequencies of how many responses fell into each category are displayed in Figure 5.1.

Table 5.5 *Quotations on motivation to take insulin as prescribed by category.*

Category	Representative quotations
Better results	<p>‘Seeing the improvement in levels for the effort put in.’</p> <p>‘Perfect control - not interested unless it's perfect.’</p> <p>‘Achieving good results.’</p> <p>‘Feeling like things are 'going well' with my control.’</p> <p>‘If I could perfectly know what my levels would be in 4-5 hours.’ later and not have to worry.’</p> <p>‘Guarantee of no hypo.’</p> <p>‘When you can see it's working and my sugar levels are steady and predictable’</p>
More support and acceptance	<p>‘Some encouragement from the healthcare team would be nice, but that never happens.’</p> <p>‘An appreciation and understanding by those around me, so that I don't feel like I'm continually fighting an unequal and unfair battle with both my body and their ignorance.’</p> <p>‘If it was more accepted by work colleagues, and when I take time to deal with diabetes it isn't frowned upon, and I am not made to make the time up.’</p> <p>‘I would also be motivated by having a care team member tell me "good job" or "improve on this"’</p> <p>‘We have "pump meetings" twice a year. They are a good pick me up we can discuss what's working and not working for each individual, you know you're not alone.’</p> <p>‘A healthcare plan with some goals would help with motivation, but I've never had one’</p> <p>‘Strangers/ others not asking stupid questions, being more educated’</p>
Diabetes equipment	<p>‘Maybe CGMs would help here as I could mitigate the risk of large changes and bad bloods and thus negative mood effects on insulin injecting.’</p> <p>‘Perhaps having pump and so easier to take frequent small doses.’</p> <p>‘Having equipment that I could use discretely when around people and having insulin infused.’</p> <p>‘Having an insulin pump definitely, it's way more easy to use a pump in public than an insulin pen, an insulin pump have less stigma associated and it's more discreet.’</p> <p>‘Random things, like suddenly winning an insulin pump upgrade or small things like getting a medical alert or glucose tablets.’</p> <p>‘Pump attached, it's never out of reach and the working out of doses is done by it, so no excuse.’</p>
Long-term health:	<p>‘Knowing health risks caused by poor diabetes control.’</p> <p>‘I want to stay healthy: I don't want to get complications and die before my time.’</p>
Motivated to	<p>‘I am very aware (to the extent of obsessive) of the potential complications of diabetes -</p>

prevent complications	<p>even if my diet is not always ideal I become paranoid if my blood sugars go high as I am terrified of what could happen if I get it wrong.'</p> <p>'Seeing someone ill and realising how important it is.'</p> <p>'Prevention of complications when I'm older and have a family.'</p> <p>'I am scared of the damage that hyperglycemia can cause, I have seen too many amputations, it is scary'</p> <p>'Knowing I still have a chance to save my body from acute and chronic complications of diabetes.'</p> <p>'I have a 9 month old daughter and I want to be ok to look after her, I value my life and my health, and want to be as healthy as I am physically able to.'</p>
Short-term effects:	'Wanting levels to be close to target to avoid feeling crappy due to too high or too low numbers.'
Wanting to avoid feeling bad	<p>'If I don't I will not feel good.'</p> <p>'Knowing my blood sugars will be up if I don't and I'll feel rubbish!'</p> <p>'The idea of feeling awful if I didn't take it.'</p> <p>'It makes you feel better. The effort is worth it, but a drag at the time.'</p> <p>'Avoiding feeling sick (nausea is inevitable for me with high blood sugars)'</p>
More monitoring	<p>'Seeing my CGM graph significantly affects my behaviour and my motivation to eat sensibly and try to maintain decent blood sugars. It has a VERY strong motivational effect on me and my behaviour.'</p> <p>'Another motivator would be having all my data (from my pump and Dexcom) all in one spot in an easy to read format so I can see trends and know what to change without having to look too hard.'</p> <p>'CGM helps keep me on track & without it I'm certain my control would suffer significantly. Plus I'd never bother keeping written records which I've hated doing throughout my life. Pans and CHM automatically record everything so life that huge burden to write stuff down which is so time consuming.... And few Dr's ever look at them after asking you to keep records yet they criticise if you don't do it. A double bind situation you can never win!'</p> <p>'More regular hba1c testing.'</p> <p>'Keeping a record of all diabetic related movements in a record diary.'</p> <p>'I'm using freestyle libre and it is soooo enlightening - it is like having a conversation with my bg levels and means I am now making more informed choices.'</p> <p>'Having constant contact [with the care team] and the ability to send data.'</p> <p>'Reminders that forced me to do it at the correct times.'</p>
Lifestyle factors	'I'd love to. But I feel the regime I'm on currently doesn't suit the life I lead. Long-lasting insulin is a nightmare to manage. I am active, and the ratios I am on currently often lead to

	<p>highs and lows following exercise. I also travel a lot and find it hard to ensure correct levels, so I tend to underdose my Levemir. I also occasionally drink alcohol (once or twice a month) and this really upsets my levels.'</p> <p>'Living a more relaxed way of life having time and place to control it.'</p> <p>'Being in my usual routine, but without pressure.'</p> <p>'Knowing that I'm about to eat and what I'm about to eat.'</p> <p>'Calm, focused, a none pressured environment I can get on with things.'</p>
Feeling good	<p>'Good feelings, being happy and not tired all the time.'</p> <p>'Feeling happy and positive more often. Diabetes appears to make me feel, in the long-term, depressed. I would like to have stable mood and a positive outlook.'</p> <p>'Good energy, the personal determination to say to myself that I am going to keep fighting this.'</p> <p>'When I'm feeling in a positive mood about diabetes.'</p> <p>'Feeling well, feeling like things are 'going well' with my control.'</p> <p>'When I'm in a good mood'</p> <p>'Being positive more often, not feeling rushed or embarrassed about my diabetes.'</p> <p>'Good feelings, being happy and not tired all the time.'</p>
Weight control	<p>'Less weight gain.'</p> <p>'Weight loss.'</p>
Confidence	<p>'Knowing that I won't get low blood sugar or feeling more confident to treat one.'</p> <p>'Confidence to treat hypos on my own.'</p>
High blood sugar	<p>'High blood sugar due mainly to cold/flu.'</p> <p>'When I remember or I start getting symptoms I'm running high so I take down insulin.'</p> <p>'To get long term blood sugar down.'</p>

Figure 5.1 *Categories and frequency of responses for motivation to take insulin*

These responses provided a number of motivational factors reported by participants which would help, or does help, them to take their insulin as they should.

5.3.5 Feedback on Insulin Questionnaire

Suggestions for further improvements to the questionnaire were actively sought from participants. In total, 80 (34.6%) of all participants provided a response to the penultimate question on the overall questionnaire, which stated: ‘We are really interested in your feedback on the Insulin Questionnaire (questions 21-36). Do you have any comments about this?’. The most frequently reported suggestion was to provide capacity to allow participants to give more detail about their insulin regime, such as the effect of technology on insulin control, the opportunity to report on previous diabetic control (for example as a teenager), and asking about miss-timed doses. Comments were also made on the wording, and overall experience of the questionnaire. Some participants (n=38, representing 47.5% of responses to this

question) used this space to write reflections about their experiences of diabetes generally. Such comments were included in other appropriate sections of the analysis or results (for example with mood) as indicated, and so are not also included here. The responses which included suggestions given by participants, comments made about the questionnaire, and participant's personal experience of the questionnaire are recorded in Table 5.6.

Table 5.6 *Quotations for feedback on insulin questionnaire by category.*

Category	Responses
Suggestions	<p>'I think that the questionnaire could also specifically question delayed/miss-timed bolusing, which can be equally detrimental to the health of the person with diabetes.'</p> <p>'It would be very beneficial if you looked at the psychological aspects and how to integrate it into treatment.'</p> <p>'Might be helpful to put in questions about how you take insulin. My experience has been dramatically improved by being on a pump.'</p> <p>'You don't take account of those using technology & should do!'</p> <p>'I now have much better control due to onset of complications from poor control in my past (HbA1c of 7.6 now, had been up to 14 in the past). You need to ask about this to learn from it!'</p> <p>'It's a bit confusing. You really need to use words other than "skip (missing)" - if you want to distinguish between a deliberate choice not to take insulin and the 'oh bwgrie, I forgot to bolus'. If you want to include both, say so.'</p> <p>'A survey like this would be better face to face to see if you can extract the real emotion out of someone instead of behind a screen.'</p>
Personal responses to the questionnaire	<p>'This has actually been very helpful for me: being able to think about, analyse and review my own behaviours when administering insulin.'</p> <p>'Made me think about why I take insulin'</p> <p>'Interesting questions I haven't heard before.'</p> <p>'This is a great area of the questionnaire and if honest can provide a lot of personalised information about diabetes control in real life situations.'</p> <p>'They appear to be quite random and not well thought out in my opinion'</p> <p>'Don't really understand what these questions are getting at.'</p> <p>'It made me think a bit more about my diabetes care so thank you'</p>

Further comments	<p>‘My slight concern for your study is that by circulating it through social media you may skew the results. In my experience people on these groups tend to be trying really hard to deal with their condition proactively. You may be missing people who are less engaged.’</p> <p>‘They are really good questions to ask and hopefully this research will help more young adults in the future to cope before something bad happens’</p> <p>‘I don't think the questions are likely to get many result from me re: insulin as was focused on missing doses not on carb counting, adjusting insulin incl sick day rules or different doses at different times of the day/month.’</p> <p>‘Reasonable questions to ask, but I am not sure if any 'reliable' conclusions will be reached. I believe that people's insulin taking would depend massively on how much they have accepted their diagnosis and their understanding of what Diabetes complications may possibly ensue, if they have uncontrolled blood sugars.’</p> <p>‘Some questions are repetitive’</p> <p>‘Just that there are so many things that affect sugar levels, some with immediate effect, some with time delays, whereas the survey reads like there is a definite right and wrong. I may miscalculate a dose or forget a dose, but its not intentionally wrong.’</p> <p>‘I'm not sure that the majority of diabetics on insulin deliberately forget to take their insulin. The reason being is that you don't feel right.’</p> <p>‘While the questions seem focused on recent behaviour, my skipping and ignoring dosing was more further back (over a decade ago).’</p> <p>‘A lot of the questions don't apply in the same way for diabetics using a pump (I think)’</p> <p>‘Sadly I think a lot of people will lie and not answer honestly in fear its recorded somewhere that there doctor can see.’</p> <p>‘Bit blunt and black and white. Can have negative feelings but still take proper dose at proper time’</p> <p>‘It was quick’</p>
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These responses provided helpful suggestions for further adaptation of the questionnaire. In particular, they suggested the option for more detail about their insulin regime or history to be given, and commented that in some cases the wording or clarity could be improved. Of those providing a comment on their personal

experience of the questionnaire, the majority reporting finding it a helpful exercise that encouraged them to think more about their insulin or diabetes care.

5.4 Recruitment Location

In response to the final question ‘where did you hear about this study?’, 87.3% of the 150 participants who responded reported finding the study online, including through Facebook support groups, diabetes.co.uk, or diabetes.org. A further 9.3% reported seeing the study at their diabetes clinic, and the final 2.7% reported hearing about the study through friends or family.

Chapter Six

Discussion and Critical Evaluation

This chapter will provide a discussion of the research findings, including the strengths and limitations of the research carried out, the theoretical implications, any clinical implications, and directions for future research.

6.1 Research Aims

This thesis project was designed to explore insulin omission in adults with type 1 diabetes. Several specific research aims were identified, these included: 1) To critically review, assess, and evaluate the way that adherence to insulin medication had been measured in previous studies. 2) To develop an appropriate measure of insulin omission for use in this study. 3) To investigate the relationships between insulin omission, general self-efficacy, diabetes specific self-efficacy, depression, and diabetes self-management. 4) To investigate reasons for insulin omission.

6.2 Summary of Main Results

First, the current systematic review highlighted the relative lack of research investigating insulin adherence in an adult type 1 diabetes population. It identified that within existing studies, the most common method of measuring adherence was by self-report questionnaire. The questionnaires reviewed were not always specific to the measurement of insulin, were sometimes worded insensitively, and did not allow scope for reasons for non-adherence to be reported. The systematic review also identified additional measurement issues, such as the lack of consistency in the measurement of adherence, the combining of type 1 and type 2 diabetes populations in studies, and the lack of a consistent cut off between what is considered ‘adherence’ and ‘non-adherence’. It was therefore concluded that a new measure which builds upon and develops existing measures of insulin omission would be necessary to meet the needs of those with type 1 diabetes.

Second, a five-stage questionnaire development process was carried out, which aimed to create a measure for assessing insulin omission which addressed some of the measurement issues outlined. The measure was designed based on findings from the limited previous research in this area, and was used selectively with people with type 1 diabetes to avoid the merging of information from heterogeneous groups. The stages involved developing a draft questionnaire by adapting and building on existing measures, requesting feedback from a multi-disciplinary diabetes clinical team, requesting feedback from people with type 1 diabetes, amending the measure based on the feedback, and requesting further feedback before the questionnaire was finalised. A 16-item questionnaire was produced (Available in Appendix K).

Third, relationships between insulin omission, general self-efficacy, diabetes specific self-efficacy, mood, and diabetes self-management were investigated using an online questionnaire survey including the measure of insulin omission developed. Results showed that insulin omission was reported by 29.9% of respondents, and was associated with lower general self-efficacy, lower diabetes specific self-efficacy, higher depression scores, and poorer diabetes self-management. In addition, those who omitted insulin were younger than those who did not.

Fourth, participants gave narrative responses to open-ended questions on reasons for insulin omission. Responses provided were analysed using Braun and Clarke's (2006) six-stage thematic analysis. The themes generated comprised of: a) Prioritising: Forgetting and the demands of daily lifestyle, b) Diabetes related emotional distress c) Weight control, d) Avoidance: Fear of physical effects, and d) Adaptive responses to managing blood sugar levels.

6.3 Summary of Additional Findings

As well as providing evidence in response to the four key aims described above, the empirical study generated additional findings of relevance to this project. These included a number of quantitative results, including finding that those with poor diabetes self-management also had higher depression scores, lower general self-efficacy scores, and lower diabetes specific self-efficacy scores. Furthermore, those with higher depression scores also had lower general self-efficacy scores, and lower diabetes specific self-efficacy scores. Higher general self-efficacy scores were also associated with higher diabetes specific self-efficacy scores.

Additionally, further qualitative data collected provided information on what might motivate people to take their insulin as they should. These responses included experiencing better (or perfect) results from taking insulin, having more support and acceptance from close circles well as professionals, having better equipment, an awareness of the long-term health complications, feeling better in the short term after taking insulin appropriately, more monitoring such as continuous glucose monitoring (CGM), and better record keeping and reminders.

The insulin omission questionnaire provided additional details on patterns of insulin omission. Participants in the sample were more likely to miss their evening dose of insulin compared to other times of day, and were more likely to miss their short acting insulin dose compared to their long acting dose. Overall just under half of participants said that they would not speak to their diabetes team about missing insulin doses. In this sample, a greater proportion of the men said that they would tell their diabetes team if they were missing insulin doses compared to women.

6.4 Links with Previous Literature

6.4.1 Systematic Review

Findings from the current systematic review are consistent with those of previous reviews of insulin adherence. Clifford et al. (2014) reviewed methodologies used to assess medication adherence in type 1 and type 2 diabetes across the age range, and commented on the lack of consensus on the best method to measure adherence. They called for greater consistency in measurement, including question content, recall period, and response options. Stolpe et al. (2016) reviewed methodologies used for assessing insulin adherence in a type 1 and type 2 diabetes adult population. They outlined the challenges in measurement styles reviewed including limited accuracy of the measurement used, complexity of data collection, and lack of a validated threshold for good adherence. The current systematic review was the first to review studies of insulin adherence in an exclusively type 1 diabetes adult population, and revealed similar issues with measurement in type 1 diabetes as described in type 2 diabetes or mixed populations. In the current systematic review a large variation in the rates of adherences were reported, as well variation in the way that adherence was measured including questionnaires, interviews, databases, and medical monitoring, and within questionnaires in the way that questions were worded. Further, there was a lack of measures that were empirically validated as questionnaires for use in measuring insulin adherence in type 1 diabetes.

The current systematic review found the most commonly used method for measuring adherence in type 1 diabetes was patient self-report, using questionnaire methods in particular. Clifford et al. (2014) reported a similar finding, with 37 (61.7%) of their total 60 studies using a patient self-report measure. In addition, they

found that all of the 14 type 1 diabetes studies they reviewed used some form of self-report, with none of these using a pharmacy database measure of adherence. In contrast, Stolpe et al. (2016), who reviewed only two studies of type 1 diabetes, (the remaining 76 being either type 2 diabetes or mixed populations), reported the most commonly used method of measuring adherence was medications possession ratio. This is a calculation using prescription data from pharmacy claims databases, whereby the total days' supply of all prescriptions in a defined period are divided by the number of days in the defined period. They found that the top five most common methods of measuring adherence all used data from pharmacy claims databases, with a self-report questionnaire being the sixth most common method of measurement. While pharmacy claims databases have commonly been used for measuring medication adherence in type 2 diabetes or mixed populations, they have rarely been used for this purpose in type 1 diabetes. It may be that, given the greater numbers of people with type 2 diabetes compared to type 1 diabetes (Diabetes UK, 2017d), pharmacy claims databases are a more popular way of collecting the large amounts of data available about adherence in this population. Stolpe et al. (2016) state that calculating adherence using a pharmacy database is relatively easy, and therefore may be attractive to researchers for this reason. However, they also point out that the presence of a pharmacy claim does not necessarily indicate that the medication has been taken. This method also does not allow for any exploration or understanding of non-adherence of insulin. The discrepancy in findings between measurement of adherence in type 1 and type 2 diabetes highlights the need to separate these conditions when reviewing research.

The current systematic review highlighted that within the measurement of insulin adherence there was little or no opportunity for participants to comment on

why they were non-adherent, including not being able to report if they were adaptively taking less or more insulin than prescribed. There is an assumption that if, for example, participants collect less insulin from the pharmacy than they require, or state that they sometimes take less insulin than prescribed, that this is a maladaptive response. While it is the case that restricting or omitting insulin has been associated with worse clinical outcomes (Goebel-Fabbri et al., 2008) the self-management of diabetes requires individuals to manage their blood sugar levels in response to a number of different potential variables. It may therefore be the case that some individuals who were appropriately missing insulin doses in response to for example, a low blood sugar reading, were included with this group. This potential for merging both appropriate and inappropriate self-management behaviours as negative has been a criticism of other measurement in diabetes adherence (Martyn-Nemeth, Farabi, Mihailescu, Nemeth, & Quinn, 2016), and existing measures of insulin omission did not appear to control for this.

6.4.2 Insulin Omission Prevalence

The insulin measure developed during the five-stage process was designed to address these issues, and focused on insulin omission (missing out insulin doses) as a subsection of insulin adherence (taking insulin as prescribed), as well as measuring insulin restriction (taking less insulin than required) and insulin over-dosing (taking more insulin than required). The rate of insulin omission and/or restriction reported by participants using the current study measure (47.8%) was higher compared to previous research e.g. 33.2% by Peyrot et al. (2012a) and 30.5% by Polonsky et al. (1994). It is possible that the higher rate reported in this study is due to the opportunity for anonymous responding which may have facilitating increased disclosure from participants (Singer et al., 1993). The higher rate of insulin omission

(only) reported by Peyrot et al. (2010) (57.0% compared to 29.9% in this study) may be due to the inclusion of people with type 2 diabetes, since this population was found to be more likely to omit insulin (Peyrot et al., 2012b).

6.4.3 Depression

The relationship found in the current empirical paper between insulin omission and depression ratings is consistent with the results of Trief et al. (2014), who reported that, in their sample, participants with depression were more likely to miss insulin doses. This finding is in contrast to results reported by Peyrot et al.'s study (2012b), which found no link between a history of depression and insulin omission. Depression status in the study by Peyrot et al. (2012b) was characterized by the response to a yes or no question about a history of depression, which is likely to be a less sensitive measure of depression than the present day focused and continuous measure used in the current study (the Patient Health Questionnaire 9; PHQ9; Kroenke, Spitzer, & Williams 2001). Current findings and those of Trief et al. (2014) also contrast with the findings from Sullivan (2012) who, using an interview study, found that depression was not reported as a main reason for insulin omission. This variability in the findings on the nature of the relationship between depression and insulin omission may be a reflection of the measurement used, for example the use of the PHQ-9 (Kroenke et al., 2001) and the use of a large sample size are common to the current study and that of Trief et al. (2014). This contrasts with the use of a depression history (defined by responses to 1 question) (Peyrot et al., 2012b) and the use of a small sample size and interview methodology (n=13) (Sullivan, 2012).

Further, the association between depression and diabetes self-management in people with type 1 diabetes has been established in previous research.

For example, depression has been found to be associated with poorer self-management of diabetes, measured by poorer medication adherence, very infrequent exercise, non-healthy diet, more smoking (Lin et al., 2004), and poorer hbA1C levels (Ciechanowski, Katon, Russo, & Hirsch, 2003).

Unlike the Trief et al. (2014) paper, the current study did not attempt to define a clinical cut off for depression for either diagnostic or group comparison purposes, analyzing scores instead along a continuous scale. This decision was made due to a number of criticisms about the way depression had been diagnosed in people with diabetes, with studies (e.g. Gonzalez, Kane, Binko, Shapira, & Hoogendoorn, 2016) outlining the over-identification of depression in those with diabetes. Fisher et al. (2010) found that most patients with diabetes and high levels of depressive symptoms on a questionnaire did not meet criteria for major depressive disorder. It was therefore felt that to use a ‘depressed’ versus ‘non-depressed’ group would be unhelpful and potentially misleading, and scores in the current study were analysed along a spectrum of low mood instead. Fisher et al. (2010) suggest that the questionnaire measure of depression used in their study, a 20 item self-report scale, may in fact be more reflective of general emotional and diabetes specific distress than clinical depression.

6.4.4 Self-efficacy

Self-efficacy is an individual’s belief in their abilities to carry out behaviours (Bandura, 1982), and is measured both as general self-efficacy and specifically in relation to diabetes in the current empirical paper. A relationship between insulin omission and self-efficacy had not previously been established, and so the finding that insulin omission is associated with both general and diabetes specific lower self-efficacy is novel. Sarkar, Fisher, and Schillinger (2006) investigated self-efficacy in

relation to diabetes self-management in type 2 diabetes in an interview study, and separated self-management into different domains of diet, exercise, self-monitoring of blood glucose levels, and medication adherence. Medication adherence was assessed by asking about whether any diabetes pills had been missed in the previous week. They found that in this population, increases in self-efficacy as measured by a four-item self-report questionnaire, were *not* associated with greater medication adherence, but were associated with improvements in diet, exercise, and self-monitoring of blood glucose levels. Aljasem, Peyrot, Wissow, and Rubin (2001) found that in their self-report questionnaire study that greater self-efficacy predicted less frequent skipping of medication in those with type 2 diabetes. This finding is distinctive from insulin omission because those with type 2 diabetes may not need to take insulin, and may take other medications (oral hypoglycemia agents) in pill form (Inzucchi, 2002). They also found that self-efficacy predicted more frequent blood glucose testing, less frequent binge eating, and greater adherence to an ideal diet. In the current empirical study the finding of a relationship between better general and diabetes specific self-efficacy and better diabetes self-management support the association between self-efficacy and diabetes self-management found in the studies described. However, the findings, diverge from those of Sarkar et al. (2006) by demonstrating a clear relationship between insulin omission, (an aspect of medication adherence), and both lower general self-efficacy, and lower diabetes specific self-efficacy. Differences between the current study and the Sarker et al. (2006) study include the participant population and types of diabetes, different measures of self-efficacy and medication adherence including potentially different medications, and differences in methodology. Sarker et al. (2006) suggest a possible reason for the lack of relationship between self-efficacy and medication adherence in

their study may be that medication adherence was not accurately measured by the self-report interview methodology. Garber et al. (2004) report that interview methods have poorer associations with other measures of adherence such as clinician report and medical monitoring when compared to questionnaire methods. They suggest that this may be due to the greater level of specificity in questionnaires compared to interviews, or because of the greater perception of anonymity afforded by questionnaires. It is possible therefore that the significant association between medication adherence and self-efficacy found in the current study and by Aljasem et al. (2001) reflect the questionnaire assessment of medication adherence compared to the interview methods used by Sarker et al. (2006), although the differences in populations might also account for the disparity in findings.

The relationship found in the present study between elevated scores on a measure of depression and lower self-efficacy is consistent with previous research in this area. For example, Flett, Panico, and Hewitt (2011) found that adolescents with elevated depressive symptoms also had lower levels of self-efficacy, while Phillips and McAuley (2013) found that depression and self-efficacy were correlated when examining fatigue in breast cancer survivors. This has also been investigated specifically in type 2 diabetes, with Sacco et al. (2005) finding that self-efficacy and depression were associated with each other and with diet and exercise adherence in this population.

6.4.5 Reports of Reasons for Insulin Omission

The themes generated from the narrative accounts about insulin omission are also consistent with previous research. The theme which encapsulated the largest number of responses from participants (56.5%) was 'Prioritising: Forgetting and the demands of daily lifestyle'. This included participants' accounts of being too busy,

being distracted, forgetting, delaying and then forgetting, being out of their routine, or being too tired to take insulin. Similar results were found in the Global Attitudes of Patients and Physicians in Insulin Therapy (GAPP), a multi-national survey of patients and providers using computer-assisted telephone interviewing (with patients) and internet surveying (with physicians). The results of this reported by Peyrot et al. (2012a) demonstrated that being ‘too busy’ and ‘travelling’ were the most popular responses selected by patients as reasons why they might miss insulin doses. Forgetting was the seventh most popular response selected by patients, while physicians rated it eleventh, rating being ‘too busy’ and ‘travelling’ in the top three reasons for insulin omission as reported by their typical patient. This finding is also compatible with the results of Sullivan (2012), who reported that for 11 of 13 participants interviewed, ‘forgetting’ or ‘delaying and then forgetting’ were described as a reason for insulin omission. Captured within this domain, Sullivan illustrates the participants’ accounts of being “too busy”, being “distracted”, or being “on the go”, which were also described by participants in the current study in this dominant theme.

Although lifestyle factors are described by these studies, Sullivan (2012) comments on the possibility of psychological reasons for “forgetting” to take insulin. Non-acceptance of diabetes, underestimation of the need to take insulin, or a resistance to the idea of taking insulin regularly are proposed as potential explanations for forgetting (Sullivan, 2012). Brod, Kongso, Lessard, and Christensen (2009) discuss psychological insulin resistance, defining this as “psychological opposition towards insulin use in both people with diabetes and their prescribers” (p.29). It is possible that such factors, although not always explicitly described, may play a part in patients forgetting to take their insulin. In support of this, some

participants in the current empirical study wrote about forgetting being related to mood, for example one participant wrote: “When I’m having down days and feeling a bit sorry for myself I tend to “forget” I have diabetes” while another wrote “Sometimes I just want to forget I have diabetes, sometimes I am just fed up of injecting as I have already done it 4 times in 1 day”. However other participants’ responses appeared to be less emotionally driven for example, one participant commented as a reason for insulin omission: “Forgetting, not being able to remember. Task is so repetitive on any given day I can’t know for sure if I have done it or not”. Studies of forgetting have also linked forgetting medication to age and to levels of activity (Neupert, Patterson, David, & Allaire, 2011), and have demonstrated in a type 2 diabetes sample that a simple regular text reminder improved long-term adherence to oral medication (Vervloet et al., 2014). It is possible that “forgetting” encompasses a range of factors for different patients at different times, and that although widely acknowledged, our understanding of the complexities of this may currently be limited and therefore an area for future research.

The second most common reason for insulin omission in the current study was labelled as diabetes related emotional distress. This theme covered a range of negative emotional responses to diabetes, including a sense of hopelessness, anger, resentment, and frustration with diabetes or insulin. Peyrot et al. (2012a) offered the pre-selected answer of “stress/emotional problems” as an option for why a participant omitted their insulin. This was selected by patients as the fourth most common reason for omitting insulin, and by physicians as the fifth most common reason in their typical patient. This category may have captured some of the same reasons described by participants in the current study, although this is difficult to

conclude given the absence of detail about the nature of the stress or emotional problems. However, distress was not reported as a significant theme by Sullivan (2012), and equally was not captured by Farsaei et al. (2014), with the exception of ‘embarrassment’ as a barrier to insulin adherence, which was not described further.

Diabetes related emotional distress is a recognised construct within diabetes care, with Polonsky et al. (2005) developing a “Diabetes Distress Scale” in order to measure “emotional burden”, “physician-related distress”, “regimen-related distress”, and “diabetes-related interpersonal distress”. The theme in the current study differs from this construct in that it captured those who reported wanting to reject or deny their diabetes, were embarrassed about injections, described low mood, stress, or reported feeling controlled in response to their diabetes, and did not capture any physician-related distress. It is of interest that although diabetes related distress as a quantifiable construct has been linked to glycemic control (Fisher et al., 2010), it has not previously been linked to insulin omission as described in the current study. Snoek, Bremmer, and Hermanns (2015) wrote about the related but distinct constructs of depression and diabetes distress in those with diabetes. They comment that there is some overlap between depression and diabetes distress, but ascertain that the two are not interchangeable constructs. Both diabetes distress and depression have been linked with poorer glycemic control as discussed, however it is likely that the underlying pathways differ. While depression is a mood disorder defined by the presence of a number of symptoms, and not defined by a particular cause (DSM-5; American Psychiatric Association, 2013), diabetes related distress is linked specifically with the experience of having diabetes (Polonsky et al., 2005). Snoek et al. (2015) found that while depression and diabetes related distress were independent factors, their findings suggested that there was some overlap and that

depression was an amplifier for diabetes related distress. This means that those who experienced depression also tended to experience worse diabetes distress. This overlap was considered in relation to some of the qualitative findings that fell into the diabetes related distress category that were also relevant to depression, such as a sense of hopelessness.

The third most commonly reported reason for insulin omission was captured by the theme of weight control. Participants wrote about a fear of weight gain related to taking insulin, and of insulin omission as a fast way to achieve weight loss. By omitting insulin, glucose cannot be absorbed by the body and is passed out in urine, resulting in the excretion of large amounts of calories (Crow, Keel, & Kendall, 1998; Schmitt, 2013). Purging calories in this way may meet the criteria for bulimia as specified by the diagnostic and statistical manual of mental disorders (DSM-V; American Psychiatric Association, 2013), which specifies “recurrent inappropriate compensatory behaviours in order to prevent weight gain such as... misuse of laxatives, diuretics, or other medications” (p. 345). The relationship between insulin omission and eating disorder psychopathology has been well documented, with the title ‘diabulimia’ becoming a recognised term in clinical practice (Ruth-Sahd et al., 2009). Most research in this area has focused on adolescent females (e.g. Polonsky et al., 1994), and rates of insulin restriction for weight loss in adult males and females with type 1 diabetes were reported by Bryden et al. (1999) who found this behaviour in 30% of females and no males. Polonsky et al. (1994) found that in their sample of females with type 1 diabetes aged 13-60, around 15% reported intentional insulin omission for the purpose of weight loss. The rates of insulin omission or restriction for weight loss in the current study were lower than this, representing approximately 4% of the study sample, 13% of those who omitted insulin (0 males, 8 females), and

17% of those who restricted insulin (2 males, 7 females). It is possible that the smaller prevalence of weight related insulin omission in the current study is due to the older population sampled (average age 34-41 years), given that both Peyrot et al. (2012b) and the current study found that those who reported omitting insulin were more likely to be younger.

In regard to the fourth theme generated from participants' "Avoidance: Fear of the physical effects", a review by Martyn-Nemeth, Farabi, Mihailescu, Nemeth, and Quinn, (2016) found 53 studies which investigated fear of hypoglycemia in an adult diabetes population. They concluded that a fear of hypoglycemia is a problem in that it negatively influences diabetes management and quality of life. Further, a review by Fu, Qui, and Radican (2009) found six studies which investigated a fear of insulin or fear of injections in people with diabetes, which was also encapsulated in the current theme. The review concludes that these fears are present and are associated with poor glycemic control and physical complications, including an increased risk of mortality. Of note, Farsaei et al. (2014) found that fear of hypoglycemia did not impact insulin adherence using a telephone survey, which contradicts the descriptions given by participants in the current study, many of whom state that fear of hypoglycemia is their primary reason for omitting insulin.

The final theme generated from participants' responses of 'Adaptive responses to managing blood sugar' is reflective of some participants appropriately and safely omitting insulin. Many participants noted that they administered less insulin if they were planning to exercise, if they missed a meal, or in response to a low blood sugar reading. Diabetes clinicians may recommend administering less insulin in these circumstances as part of the monitoring and self- management of diabetes (Stetson et al., 2011). This theme may be captured in Sullivan's (2012)

domain of “being in situations where there is limited access to food” and “planning to be physically active”, Peyrot’s (2012a) category of “skipped a meal”, and Farsaei et al.’s (2014) barrier of “episodes of hypoglycemia”, for all of which missing an insulin dose may be an appropriate and adaptive response. This is indicative of omission being positive and beneficial, which challenges the prevailing perception of insulin omission in the literature as a negative behaviour. It highlights times when ‘insulin omission’ may in fact be ‘self-management’, as individuals omit insulin in order to safely manage their disease as recommended by clinicians.

Although the ideas captured in the themes generated by the current study have some representation in existing research, no study to our knowledge has investigated insulin omission in such a systematic way incorporating quantitative and narrative methods. This research also builds upon areas that previously may have been confounded by the discrepancies in findings, methodology, and the inclusion of different populations of participants with diabetes.

6.4.6 Additional Findings from Insulin Measure

The results from the question about what would motivate people to adhere more closely to their insulin regime are mirrored by Kyngas (2007). In a study with adolescents, it was found that support from clinicians, internal motivation and energy, and the threat to physical wellbeing all predicted good adherence. Lin and Ciechanowsk (2008), summarising reviews of clinical trials aimed at achieving better medication adherence and diabetes outcomes, recommend that clinicians clearly explain key information when prescribing medications, assess adherence in an empathic and non-judgmental way, simplify medication taking, identify barriers to medication taking, and provide behavioural support. This may be reflected in the findings from in the current study of ‘more support and acceptance’, and ‘lifestyle

factors', where participants report feeling judged by others, and finding their diabetes regime does not fit with their daily life, respectively.

'Despite the findings that participants reported omitting, restricting, or overdosing on insulin medication, many participants (40.7%) reported always taking insulin as they should. This indicates that despite its complexity, many people do manage to adhere to their insulin regime. It is of note that a number of participants reported a fear-inducing narrative for maintaining adherence e.g. "I don't want to get complications and die before my time". It is possible that, given the perceived threat of non-adherence (e.g. early death), acknowledgment of a problem which could lead to this would be difficult for patients to accept internally and tell their health professionals. van Steenkiste et al. (2004) discuss a barrier to change in coronary risk as patients denying their risk or 'sticking their head in the sand' (p. 43). It is possible that this may also be the case for some patients with diabetes, that denial or avoidance may be easier than acknowledging openly that they are carrying out a behaviour which could have such serious consequences.'

Furthermore, of note is that some variables of interest are mentioned in the literature as important but were not reported by participants in this study. For example, participants in this study do not mention cost, which has been consistently reported as a barrier to insulin omission (e.g. Farsaei et al., 2014; a review by Davies et al., 2013). This is likely to be due to the majority of participants being from the U.K, and therefore being entitled to use the National Health Service (NHS).

Additionally, gender and delivery of insulin (e.g. injections or insulin pump or pen) have been associated with insulin omission in previous research (Pickup et al., 2002), and neither were found to be related to insulin omission in this study. In addition, in this self-report and anonymous study men reported that they were more

likely to tell their diabetes team about missing insulin injections, compared to women. These differences challenge such existing research (e.g. Caldas, Cheater, & Marshall, 2005), and add to the limited evidence base about insulin omission.

6.5 Strengths and Limitations

The current research has a number of strengths and limitations, and it is important that the results described are considered in light of these.

First, a strength of the research was the systematic evaluation of existing measures of adherence to insulin medication, which allowed for the strengths and weaknesses of each approach to be fully considered, and was invaluable in informing the development of the current insulin omission measure. ‘The final review of existing studies described in the systematic review took place in December 2016. However multiple closely related searches and appraisals of this literature were carried out from June 2016 as part of the research process for the systematic review, which also informed the empirical paper, and contributed to the development of the measure used. The issues in measurement highlighted in this review could then be addressed in the design of the new measure. Adapting and building upon existing measures ensured a degree of consistency with previous research, which was identified as lacking between studies in this area (Stolpe et al., 2016; Clifford et al., 2014).

Involving patients and clinicians in the co-production of the insulin questionnaire increased acceptability of the questions and wording, as well as attempting to ensure that the questions were focused on areas relevant to those the questionnaire was designed to help. Multiple stages of review and feedback contributed to the development of a tool that can, with further modification, be used in clinical practice.

A further strength of the research was the anonymous design utilized for the empirical study. Research has indicated that using computerized methods and methods consistent with the perception of anonymity result in greater levels of disclosure, possibly because of reduced concerns about confidentiality, and less impression management. (Lucas et al., 2014; Weisband & Kiesler, 1996). Different methodologies used for investigating insulin omission had previously given different results (e.g. Peyrot et al., 2012a; Sullivan, 2012), and it was hypothesized that an anonymous design might aid clarity by enhancing levels of disclosure. The higher levels of insulin omission and restriction found in the current study compared to other studies in type 1 diabetes, raises the possibility that participants may have previously been under-reporting this. Additionally, the range of reasons found for insulin omission had not been reported by any other single study investigating this.

However, in clinical practice, responding cannot be anonymous, and as indicated by the results, participants may not always feel able to discuss these difficulties with their clinicians. It is hoped that an awareness of this barrier, as well as a clearer understanding about why people might engage in insulin omission, may guide clinicians in their clinical questioning, facilitating a more open discussion with the intention of better supporting the patient.

A third strength of the research was the large number of participants recruited, which allowed sufficient statistical power for all of the planned analyses to be conducted. In addition, the views of many participants were captured in response to the open-ended questions, increasing the generalizability of the findings. Given that the majority of participants live in the United Kingdom (UK), the results of this study are therefore relevant to clinical practice within the UK, allowing for clear recommendations to be made to UK providers.

Balanced with the study strengths are a number of limitations which are considered next. One limitation of the research was the possible rejection of some studies measuring insulin omission and adherence from inclusion in the systematic review. Due to the criteria for including and excluding papers, a number of measures of insulin adherence and omission that had been used in mixed diabetes populations, and with children, were not considered (e.g. Peyrot et al 2012b, Peyrot et al 2012a, Polonsky, et al., 1994) This meant that in the development of the questionnaire for the empirical paper, while additional papers were taken into account, they were not integrated systematically with other adherence measurement which may have aided the development process. However, by intentionally focusing on measures used in type 1 diabetes this illuminated the lack of specific measurement for this population, as well as the discrepancy in the number of research studies in this area between type 1 diabetes and type 2 diabetes, which supported the design of the current study. Further, the review was limited to the databases searched, and was carried out by one researcher, both of which increased the potential for bias in selection and for studies to be overlooked.

A further limitation of the study was the lack of depth and detail in the narratives collected through open-ended questions. Although some participants gave more detailed responses, the majority answered with a single sentence and sometimes a single word. This therefore made the planned analysis at the semantic level (Braun & Clarke, 2006) challenging, particularly in the case of ambiguous answers, for example when participants wrote only 'I forgot'. Following guidance in Braun and Clarke's paper, which instructs that a deeper level of meaning should be considered and hypothesized even when using a semantic approach, these answers were grouped according to patterns across the data more broadly (e.g. that most

answers that mentioned forgetting also mentioned lifestyle reasons). However, the inferences made on the basis of limited information remain a limitation of the findings. While the depth that the analysis could reach in terms of making confident conclusions about the intentions of the participants was limited, the high volume of responders meant that a breadth of reasons was collected and that patterns could be observed. This increased the likelihood that the range of reasons for insulin omission found in this study could be considered to be representative of the adult type 1 diabetes UK population.

A third limitation of the study was the potential for bias in the method of recruitment. Given that the majority of participants were recruited through diabetes websites and diabetes support groups on social media, it is possible that only those actively seeking support would access and participate in the study. Research has shown that online diabetes support groups are typically used to request disease specific guidance, to share diabetes management strategies, and to receive emotional support (Greene, Choudhry, Kilabuk, & Shrank, 2011). It is therefore possible that these groups selectively attract those who identify with having diabetes, and who take an active approach to seeking support, when compared to the general population of people with type 1 diabetes. This may also be the case for the smaller number of participants who were recruited from an NHS clinic. Consequently, those who were using social media related to diabetes, and were not attending appointments at the diabetes clinic used for recruitment, were not represented in this study. This may have meant sampling was potentially biased towards those inclined to better manage their diabetes by seeking support and attending appointments.

Furthermore, the online design meant that only those who were able to use a computer, mobile phone, or tablet to complete the questionnaire were included.

The use of open-ended questions had the potential to offer difficulties to the less literate, or those less able to explain themselves, when compared to closed questions.

Women were over represented in the sample (77.9%) compared to men (22.1%), when compared to other large scale studies, for example Trief et al. (2014) reported that in an American sample of 6172 participants, 55% were women. This may be a reflection of the over-representation of women in online support groups. Krizek, Roberts, Ragan, Ferrara, and Lord, (1999) found that women were 2.5 times more likely than men to join a support group, although a review by Mo, Malik, and Coulson (2009) suggests that this evidence is mixed. The under-representation of men in this sample means that the extent to which the results of the study can be generalised is limited.

An additional limitation of the research was its reliance on self-report information. Medical indicators of adherence or omission were not collected from participants as this was beyond the scope of the current study, meaning that there was the potential for under or over reporting. It is possible therefore that the results may be biased, given the tendency for under-reporting of non-adherence in medical participants (Stirratt et al., 2015). However, evidence suggests that despite some under-reporting, self-reported adherence has a moderate effect size when compared to other adherence measures, and can significantly predict clinical outcomes (Stirratt et al., 2015; Garber et al., 2004). Further, it was hoped that some of the barriers to accurate reporting were addressed by the anonymous response design via computer, which minimized issues of confidentiality, and of impression management (Lucas, et al., 2014; Singer et al., 1993).

Further, the way that the question about insulin omission and insulin under dosing was interpreted by some participants meant that omission or under dosing

were reported as positive behaviours, forming the theme of ‘adaptive responses to managing blood sugar levels’. However, the study was designed to look at omission only as a negative behaviour (e.g. associated with depression), given that this is the prevailing perception in the literature.

6.6 Theoretical Implications

The results of this study demonstrate an association between lower self-efficacy (general and diabetes specific) and insulin omission. While the cross sectional correlational design cannot infer causality in this relationship, this finding may support a theory of self-efficacy which includes avoidance, drawing on the social learning theory concept that individuals perform activities that they can cope with and avoid activities which they cannot cope with (Bandura, 1977). The relationship between self-efficacy and avoidance has been examined in other areas, for example Rodriguez et al., (2016) found that students who had lower self-efficacy also had greater academic work avoidance. With diabetes, it may be that low self-efficacy takes the form of an avoidance of taking insulin doses, resulting in insulin omission. While the questionnaire scores are able to assess this relationship, they are not able to explain it. The narrative responses reported by participants in this study provide personal accounts which may offer some explanation as to how self-efficacy and insulin omission are related. A theme generated from the narrative responses for insulin omission described participants’ avoidance and fear of the physical effects of taking their medication may, in part, provide an explanation of this. Participants described feeling unable to cope with low blood sugar, for example at night, or while driving. This feeling of not being able to cope may be related to low self-efficacy. Participants explain or infer that as a result of this, they subsequently omit insulin.

Much of the existing research investigating insulin omission has looked at this behavior particularly in relation to weight control and eating disorders (e.g. Polonsky et al., 1994, Crow et al., 1998, Daneman, 2002). The current study supports evidence for this, with weight control being the third most commonly reported reason for insulin omission. However, this study also demonstrates in a large sample a range of associations with and narrative accounts for why people omit insulin, aside from weight. This study adds to the small but expanding evidence base about the potential multitude of factors that might cause a person to omit their insulin medication, despite the potentially harmful health consequences of this.

Evidence of insulin omission in men has rarely been reported in the literature, and in larger studies this has not been reported independently from women (e.g. Trief et al., 2014, Farsaei et al., 2014). In the current empirical study, one in three women, and just less than one in four men reported omitting insulin, with 2 (10%) of the men in this study who restricted insulin reporting doing so to achieve weight control. Evidence of men using insulin omission or restriction for weight loss has only been reported in one study to the author's knowledge (Herpertz et al., 1998). The findings of the current study should challenge any assumption that insulin omission, and insulin omission or restriction for the purpose of weight control, is confined to women.

From the narrative responses obtained in this study it was evident that a number of participants reported omitting or restricting insulin for adaptive reasons in order to safely and appropriately manage their blood sugar levels. It follows that the measurement tool, and by implication other similar measurement tools on which this tool was based, may not have separated unsafe from safe responses to insulin and this is an area for further development for the current measure.

6.7 Clinical Implications

The consistency of the reported associations between general self-efficacy, diabetes specific self-efficacy, insulin omission, and diabetes self-management demonstrate that lower self-efficacy is associated with insulin omission and worse diabetes self-management.

For patients' presenting with insulin omission, interventions that have been shown to improve self-efficacy (e.g. Snoek et al, 2008), may be beneficial and should be considered by healthcare providers. Similarly, the link between insulin omission and low mood, supported by previous research, indicates that interventions for depression may be helpful for those presenting with insulin omission and could be considered if indicated (Safren et al., 2013).

Narrative responses from participants indicating what helps them to take their insulin as they should, and what would motivate them to do this included the achievement of better results, being motivated to prevent complications, more support and acceptance from others, more monitoring, lifestyle factors, mood, weight, and confidence. There is the potential for these responses to be adapted to inform interventions and healthcare in clinical practice. For example, some participants state that they want perfect results in terms of their blood sugar control, for example a 'guarantee' of not experiencing low blood sugar in order to motivate them to take their insulin as they should, which may be unrealistic given the many factors that can influence blood glucose levels. A 'black and white' response, such as control being either perfect or bad, may lead to patients becoming unmotivated by the lack of perfect results and subsequently becoming less adherent. It is possible that interventions such as cognitive behavioural therapy (CBT; Beck, 1979) may be beneficial in challenging unhelpful expectations with regards to the management of

blood sugar, and may help patients to accept some level of uncertainty and fluctuation.

CBT for adherence and depression has been trialed by Safren et al. (2013) in patients with type 2 diabetes. They found that after four months of CBT which focused on motivational interviewing, increasing pleasurable activities, thought challenging, problem solving, and relaxing, adherence to oral medication improved and depression scores reduced. The themes generated as reasons for insulin omission by the current study provide potential areas that interventions such as CBT could consider. In particular, improving patients' self-efficacy in managing injections and episodes of hypoglycemia in order to reduce fear based avoidance of insulin doses, consideration of weight management and eating disorder psychopathology in order to support people not to use insulin omission as a weight control strategy, and attention to the appraisals that people have of their diabetes and their blood sugar control in order to reduce diabetes related emotional distress.

Further, a number of participants in this study reported that more monitoring would be helpful for them, which may be able to be negotiated with diabetes teams for those patients for whom insulin omission is a problem. Interventions such as text reminders or alerts, glucose monitoring equipment, or more frequent appointments might be helpful in these cases. Given that knowledge of the long-term effects of insulin omission was a motivator to take insulin appropriately by many, it is possible that additional education about this may be helpful when indicated.

Importantly, the variety of reasons reported as motivators to take insulin offered by participants in this study demonstrates that patients often have ideas about what might be helpful for them, and that many of these may be able to be provided or outsourced by diabetes teams. Using the knowledge of both patient and

professionals collaboratively may facilitate better outcomes in patients (Lin & Ciechanowski, 2008).

‘Almost half of participants in this study reported that they would not, or do not, tell their diabetes team about insulin omission. One explanation for this non-disclosure is the potential shame or stigma associated with poor diabetes management. Shabon (2015) discusses stigma and shame in diabetes in the context of poor diabetes management eliciting negative thoughts in people with diabetes, such as about not being ‘good enough’, or having ‘failed’, and the fear being judged or blamed by professionals for this. This is also discussed by Archer (2014), and suggestions made for professionals dealing with shame in diabetes including an awareness of non-verbal cues, and training to deliver emotional and psychological support. The results of this study should provide insight into the extent of this potential underreporting of insulin omission, and encourage clinicians to consider ways to support their patients in being able to share this information. The questionnaire developed by this research project or an adapted screening form of this measure may provide one way of directly assessing insulin omission in clinical practice.’

6.8 Future Work

With regards to the relationship between insulin omission and depression, establishing the nature and direction of this relationship is beyond the scope of the current study, for example it cannot say whether those that report high levels of depression find it more difficult to manage their diabetes and take insulin, or whether the side effects of not taking insulin appropriately put patients at risk of low mood. Future studies could use a longitudinal design in order to better understand the direction of the relationship between mood and insulin omission.

Future work might also investigate whether the relationships demonstrated in this predominantly UK, type 1 diabetes, adult population between insulin omission and self-efficacy, are similar in those with type 2 diabetes, those under the age of 18, and beyond the UK. This would provide information about the generalisability the relationship between self-efficacy and insulin omission, and might indicate whether developing standardized interventions to improve self-efficacy in those who omit insulin would be appropriate across these groups.

The measure developed in this study may, following further work, be modified for use in clinical practice. Potential considerations for modification are recommended following the results of the study, and feedback from participants about the measure. Firstly, a number of participants reported safely and appropriately omitting or restricting insulin, and were captured in the 'insulin omission' or 'insulin restriction' group, which aimed to identify use of insulin medication which could negatively impact health. This was also identified by a participant in the feedback who suggested that the wording was 'a bit confusing'. Future work could look at refining the questions used in order that those who safely and appropriately manage their blood sugar through not taking, or restricting their insulin, are easily distinguishable and separated. Second, as suggested by four participants, other areas of insulin adherence could be added. For example, the timing of insulin doses is not mentioned in this study, but mistimed doses can also cause high blood sugar and subsequently be damaging to patients (Brod, Rana & Barnett, 2012). Third, it may be helpful to adapt the themes generated from open-ended questions into closed question responses to provide a quantitative assessment of attitudes and behaviours reported in the narrative responses. Using patient data to shorten the questionnaire to

a screening measure for clinicians to use may provide a time efficient way of collecting information in clinical practice.

Ideally future work will establish agreement on the definition and measurement of insulin omission, and of insulin adherence in general. The related area of under-dosing also merits further investigation. Additionally, the commonly reported area of “forgetting” and the psychological processes associated with this are little understood and therefore further research may be helpful. Future research may also consider interventions to target insulin omission and under dosing (where both are a maladaptive response), and work towards ultimately improving the health and wellbeing of those for whom this is a problem.

6.9 Conclusion

The current research reviewed existing measures of insulin adherence in type 1 diabetes, and developed a measure of insulin omission. The results of the empirical study showed that approximately one third of participants reported insulin omission, and that this was related to both lower self-efficacy and higher depression scores. Reasons for insulin omission reported by participants in this study could usefully be considered to fall under a number of common themes including a) Prioritising: Forgetting and the demands of daily lifestyle, b) Diabetes related emotional distress, c) Weight control, d) Avoidance: Fear of physical effects, and e) Adaptive responses to managing blood sugar levels.

The questionnaire developed in this study could, with adaption, be used in clinical practice as an assessment tool, facilitating communication about insulin omission between patients and clinicians. It is hoped that this will promote openness and better understanding between patients and clinicians, allowing them to collaboratively work together to decrease insulin omission.

If successful, a reduction in insulin omission has the potential to help to not only reduce the risk of complications, but potentially to improve the longevity and quality of life in patients with type 1 diabetes.

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Appendices

Appendix A

Formatting Guidance for Diabetes Care Journal

Available from <http://care.diabetesjournals.org/content/instructions-for-authors#Section6>



Guidelines for Systematic Reviews and Meta-Analyses

Systematic reviews and meta-analyses are systematic, critical assessments of literature and data sources pertaining to clinical topics that emphasize factors such as cause, diagnosis, prognosis, therapy, or prevention. Meta-analyses that address questions for which there is clinical equipoise are preferred.

All articles or data sources should be searched for and selected systematically for inclusion and critically evaluated, and the search and selection process should be described in the manuscript. The specific type of study or analysis, population, intervention, exposure, and tests or outcomes should be described for each article or data source (PICOS format). The data sources should be as current as possible, ideally with the search having been conducted within several months of manuscript submission.

For meta-analyses of randomized controlled trials, follow [PRISMA reporting guidelines and checklist](#). For meta-analyses of observational studies in epidemiology, follow [MOOSE reporting guidelines](#).

Meta-analyses and systematic reviews not following these guidelines will not be peer reviewed. Additional criteria appear below.

Title

Include either “meta-analysis” or “systematic review,” as appropriate, in a subtitle following the title.

Abstract

Word limit: 250 words

Structure with the following headings: **Background, Purpose, Data Sources, Study Selection, Data Extraction, Data Synthesis, Limitations, Conclusions.**

Manuscript

Word limit: 5,000 words (excluding abstract and references)

Please format with the following sections: **Introduction, Methods, Results, and Discussion.** **End the Introduction section with a clear statement of the study’s objectives or hypotheses.**

The Methods section should include the following subheadings:

- Data Sources and Searches
- Study Selection
- Data Extraction and Quality Assessment
- Data Synthesis and Analysis

For studies that have numerical data and use statistical inference, include a section under Methods that describes the methods and specific statistical software used for the statistical analyses.

References: minimum 40, maximum 60 citations

Tables and figures: Any combination of 4 tables and/or figures will be accepted—Include a flow diagram that depicts search and selection processes, along with evidence tables.

5.1. Original Articles. Original Articles should be arranged in the following order: title page, structured abstract, introduction (no heading), "Research Design and Methods," "Results," "Conclusions," "Acknowledgments," "References," tables, and figure legends.

A **structured abstract** is required for all Original Articles. Abstracts for an Original Article should not exceed 250 words. (This is not to be confused with abstracts submitted to the Annual Scientific Meeting, for which the word limit is higher.) The abstract must be self-contained and clear without reference to the text and should be written for a general journal readership. The abstract format should include four sections: "Objective" (the purpose or hypothesis of study), "Research Design and Methods" (the basic design, setting, number of participants and selection criteria, treatment or intervention, and methods of assessment), "Results" (significant data found), and "Conclusions" (the validity, limitations, and clinical applicability of the study and its results).

The **Conclusions** section should discuss the findings of the study in the context of past research concerning the topic of the article, in particular highlighting how these findings add new information. Also, this section should, where possible, assess the possible clinical relevance of the findings avoiding any claim or terminology of superiority, especially when statistically significant but quantitatively modest differences are found.

The **word count limit** for Original Articles is 4,000 words, excluding words in tables, table legends, figure legends, title page, acknowledgments, and references. In addition, an original article is limited to a combination of 4 tables and figures. **References** are limited to 40 citations.

A conflict-of-interest statement for all authors must be included in the Acknowledgments section of the main document, which should follow the main text and precede the references. If there are no relevant conflicts of interest to disclose, authors should indicate as such in the Acknowledgments section.

In the case of **multicenter studies**, authors should provide a list of participating investigators in an appendix to the paper. Papers will not be reviewed if this information is not included.

Where appropriate, **clinical and epidemiological studies** should be analyzed to see if there is an effect of sex or ethnicity. If there is no effect, it should be stated as such in the "Results" section.

Randomized Clinical Trial reporting: Authors of reports on randomized controlled trials are required to use the instructions and checklist in the [Consolidated Standards of Reporting Trials \(CONSORT\) Statement](#). The instructions and checklist are designed to ensure that information pertinent to the trial is included in the study report. CONSORT information may be included in a supplemental material online-only file so that it does not affect word count limitations.

All **clinical trials** submitted to *Diabetes Care* for consideration of publication must be registered with a clinical trial registry approved by the International Committee of Medical Journal Editors (ICMJE). Please see Section 2.5 for more information.

6. MANUSCRIPT FORMAT AND STYLE

Articles must be in clear and understandable English. Non-native English authors are encouraged to seek the assistance of an English-proficient colleague, or a communications agency, such as [American Journal Experts](#), to help improve the clarity and readability of a paper before it is submitted to the journal.

For specific information on the parameters and limits for various manuscript categories (e.g., section headings, word limits, etc.), see [Section 5, Manuscript Categories](#).

6.1. Title Page. All submissions, regardless of article type, require a title page. The title page should include the following: full title; a short running title (less than 47 characters and spaces combined); the first name, middle initial, last name, and highest academic degree of each author; each author's affiliation (in English) during the time the study was conducted; contact information of the corresponding author (name, current address, telephone number, fax number, and e-mail address); and the word count and number of tables and figures.

If two authors have equal authorship, it may be noted by * under the author list.

6.2. Main Document. The main document file includes the title page, abstract, main text, acknowledgements, figure legends, references, and tables, in that order. Please do not use headers, footers, or endnotes in your paper.

The Main Document should be in Word document format (not as a PDF). This will allow our Editorial Office to verify word count and our production staff to convert your paper (if accepted) into an article.

6.3. Text Composition. Articles should be written in clear, concise English following the recommendations for scientific writing found in *Scientific Style and Format*, the Council of Science Editors (CSE) style manual (7th ed., 2006, Reston, VA, Council of Science Editors). All accepted manuscripts will be edited according to the CSE style manual and *The Chicago Manual of Style* (16th ed., 2010, Chicago, IL, The University of Chicago Press) by ADA professional publications staff. The authors are responsible for all statements made in their articles or editorials, including any editing changes made by staff. Proof pages will be sent to the corresponding author and should be read carefully.

The designations type 1 diabetes and type 2 diabetes should be used when referring to the two major forms of diabetes.

Abbreviations for diabetes, such as T2D for type 2 diabetes, should not be used. The term diabetic should not be used as a noun.

All manuscripts should be double-spaced, in Arial or Times New Roman 12-point font, and saved as a .doc, .txt, or .rtf file. In addition, please do not "lock" or "page protect" your document, and avoid using footnote and endnote functions.

6.4. Abbreviations and Units. Abbreviations should be used only when necessary, e.g., for long chemical names (HEPES), procedures (ELISA), or terms used throughout the article. See the [list of abbreviations](#) that need not be defined; all others must be defined at first use. Abbreviate units of measure only when used with numbers. Abbreviations may be used in tables and figures. The CSE style manual contains lists of standard scientific abbreviations.

Clinical laboratory values and units should be in Système International (SI) form. Kilocalories should be used rather than kilojoules.

HbA1c values should be dually reported as "% (mmol/mol)."

Please use the NGSP's HbA1c converter

at <http://www.ngsp.org/convert1.asp> to calculate HbA1c values as both % and mmol/mol.

6.5. Font. Text, including title and author names, should be in 12-point Arial or Times New Roman. Please avoid using boldface font. Text in tables should be no smaller than 10-point font.

6.6. Margins. Margins should be 1" at the top and bottom and 1" on the left and right sides.

6.7. Acknowledgments. The acknowledgments are located after the main text and before the reference list. Acknowledgments should contain the author contributions paragraph, brief statements of assistance, the guarantor's name (person[s] taking responsibility for the contents of the article), funding/financial support, conflict of interest statement, and reference to prior publication of the study in abstract form, where applicable.

6.8. References. Please place the reference list after the main text and acknowledgments (if applicable). Original Articles are limited to 40 references. Letters are allowed 5 references. Review

Articles are allowed 60 references, and meta-analyses should have no more than 40 references.

Reference numbers in the text should appear in chronological order in normal type and in parentheses [e.g., “In the study by Norton et al. (23)...”]. Please do not use the footnote or endnote function to cite studies or create a reference list. A reference manager must have the ability to customize the display of references. For example, the reference application should have the option to list the references at the end of the paper, as opposed to listing the references as endnotes or footnotes at the bottom of each page, and should not embed the list in the text as a series of endnotes/footnotes. When using a reference manager (e.g., Thomson's EndNote Reference Program), don't forget to generate the list as a bibliography in a style suitable to Diabetes Care, and then save and submit as the final step to creating the references. Otherwise, references should be manually inserted. All authors must be listed by first initials and last name in each reference, and please provide inclusive page numbers. Journal titles should be abbreviated according to the National Library of Medicine's [List of Journals Indexed for Medline](#); for unlisted journals, please provide complete journal titles. Material in press may be cited, but copies of such material may be requested. Authors are responsible for the accuracy of the references. Click [here](#) for examples of how references should be formatted.

6.9. Supplemental Material. Non-essential tables, figures, and/or videos may accompany articles as online-only supplemental material files, but authors are asked to include a comment to the editor at the time of manuscript submission that explains the rationale and justification for submitting and possibly posting the supplemental information.

All online-only supplemental material files should be combined in one document file whenever possible and uploaded during the submission process. The file must be clearly labeled as “Online-Only Supplemental Material.” In addition, supplemental material online-only files must be referenced in the main text of the manuscript at least once (e.g., “Supplemental Table S1”). All online-only supplemental material files are subject to peer review but will not be composed, copyedited, or proofread by production staff. As such, authors are encouraged to review supplemental material files carefully before submission.

Lists that include names of principal investigators or writing

groups may appear in print or as online-only supplemental material. Lists of names exceeding 150 words should be submitted as online-only supplemental material. Names of principal investigators or writing groups should otherwise be included in an in-text appendix, located at the end of the main document before the references.

Supplemental material containing very large datasets should be cited in the text with a URL to the material hosted on an author-affiliated website or may appear with a note that the data is available upon request to the author.

6.10. Tables. Each table should be inserted on a separate page at the end of the document with the table number, title, and legend indicated. Table legends should be inserted below the table and should not be included inside the table. Tables should be created using Word and the "Insert Table" command. Please use Arial or Times New Roman font, no smaller than 10-point. Tables with internal divisions are not allowed (Tables 1A and B) and should be submitted as individual tables (Tables 1 and 2). Please avoid using shading within a table. If a table includes data that require explanation in the legend, apply the following sequence of symbols, from top to bottom, left to right: *, †, ‡, §, ||, ¶, #, **, ††, ‡‡.

6.11. Figures. Diabetes Care uses digital publishing methods throughout the journal production process. If your article is accepted, it will be published in both the print and online journal. The following sections provide information on how to format your figures to ensure the best possible reproduction of your images. Size. Figures should be produced at the size they are to appear in the printed journal. Please make sure your figures will fit in one, two, or three columns in width. Multi-paneled figures should be assembled in a layout that leaves the least amount of blank space.

1 column = 13 picas wide, 2.2 in, 5.6 cm

2 columns = 28 picas wide, 4.6 in, 11.7 cm

3 columns = 41 picas, 6.8 in, 17.3 cm

Font. At 100% size, fonts should be 8-10 points and used consistently throughout all figures.

Text. Information on the axes should be succinct, using abbreviations where possible, and the label on the y-axis should read vertically, not horizontally. Key information should be placed

in any available white space within the figure; if space is not available, the information should be placed in the legend. In general, figures with multiple parts should be marked A, B, C, etc., with a description of each panel included in the legend rather than on the figure.

Line and bar graphs. Lines in graphs should be bold enough to be easily read after reduction, as should all symbols used in the figure. Data points are best marked with the following symbols, again assuring that they will be readily distinguishable after

reduction: ○ ● □ ■ △ ▲. In the figure legend, please use words rather than the symbols; e.g., "black circles = group 1; white squares = group 2; black bars = blood glucose; white bars = C-peptide." Bars should be black or white only, unless more than two datasets are being presented; additional bars should be drawn with clear bold hatch marks or stripes, not shades of gray. Line or bar graphs and flow charts should be created in black and white (if more than two datasets, multiple bars can be drawn with clear, bold hatch marks or stripes) or color (see [color printing fees](#)), not shades of gray, which are difficult to reproduce in even tones.

Formatting digital figures files for print and online reproduction. To meet ADA's quality standards for publication, it is important to submit digital art that conforms to the appropriate resolution, size, color mode, and file format. Doing so will help to avoid delays in publication and maximize the quality of images, both online and in print. Please refer to [ADA's Digital Art Guidelines](#) when preparing your files. If you are unable to provide files that meet the specifications outlined in the Guidelines, you may submit your original source files (files from the program in which they were originally created).

Reproductions. If materials (e.g., figures and/or tables) are taken from other sources, the author must provide written permission for reproduction from the original publisher and author at the time of submission. In addition, the source should be cited at the end of the figure legend. For more information, refer to [Permissions: Help for Authors](#).

Referencing style guide

Journal articles:

Banting FG, Best C. The internal secretion of the pancreas. *J Lab Clin Med* 1922;7:251-266

Abstracts:

Seaborn J. Gastrointestinal side-effects of high-fiber diets in diabetic rats (Abstract). *Gut* 1992;33:A4304

Books:

Allen FM. *Studies Concerning Glycosuria and Diabetes*. Bradley RF, Krall LP, Eds. Cambridge, MA, Harvard Univ. Press, 1913

Chapters in books:

Stauffer W, Renold AK. Pathophysiology of diabetes mellitus. In *Joslin's Diabetes Mellitus*. 11th ed. Marble A, White P, Bradley RF, Krall LP, Eds. Philadelphia, Lea & Febiger, 1971, p. 35-98

Government publications:

Fajans SS (Ed.). *Diabetes Mellitus*. Washington, DC, U.S. Govt. Printing Office, 1976 (DHEW publ. no. NIH 76-854)

Proceedings and symposia:

Steel JM. Prepregnancy counseling and the management of the pregnant woman with diabetes. In *Proceedings of the 39th Annual Advanced Postgraduate Course, Orlando, FL, 1992*. Alexandria, VA, American Diabetes Association, p. 97-98

Online publications:

Beta cell function in type 2 diabetes: glucose metabolism and insulin secretion in the normal pancreas [article online], 1999. Available from http://www.amaryl.com/TXT/Clinical_Management/Overview/beta_cell_failure_TXT.html. Accessed 4 May 2000

Appendix B

Confirmation of Ethical Approval Letter



24 May 2016

Miss Sophie Ames
 Trainee Clinical Psychologist
 CPFT
 Faculty of Medicine and Health Science
 University of East Anglia
 Norwich Research Park
 NR4 7TJ

Dear Miss Ames

Study title:	A study of adults with type 1 diabetes: investigating insulin omission
REC reference:	16/SW/0121
Protocol number:	N/A
IRAS project ID:	183272

Thank you for your letter of 20 May 2016, responding to the Proportionate Review Sub-Committee's request for changes to the documentation for the above study.

The revised documentation has been reviewed and approved by the sub-committee.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this favourable opinion letter. The expectation is that this information will be published for all studies that receive an ethical opinion but should you wish to provide a substitute contact point, wish to make a request to defer, or require further information, please contact the REC Manager, Georgina Castledine, nrescommittee.southwest-cornwall-plymouth@nhs.net. Under very limited circumstances (e.g. for student research which has received an unfavourable opinion), it may be possible to grant an exemption to the publication of the study.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.

Conditions of the favourable opinion

The REC favourable opinion is subject to the following conditions being met prior to the start

Document	Version	Date
Copies of advertisement materials for research participants [Poster phase 2]	1	23 February 2016
Covering letter on headed paper [Covering letter]	1	19 February 2016
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [Insurance and Indemnity letter]	1	22 March 2016
IRAS Checklist XML [Checklist_05042016]		05 April 2016
IRAS Checklist XML [Checklist_23052016]		23 May 2016
Non-validated questionnaire [Draft of full survey monkey questionnaire battery in order]	1	23 February 2016
Non-validated questionnaire [Insulin questionnaire]	1	23 February 2016
Non-validated questionnaire [Demographic questions]	1	23 February 2016
Other [Debrief - final page of Survey Monkey survey]	1	23 February 2016
Other [Final page of survey - debrief]	1.1	27 April 2016
Other [Ethical approval- Provisional opinion response letter]		20 May 2016
Other [Final page of survey - debrief v1.1 tracked changes]	1.1	27 April 2016
Participant consent form [Consent to contact form - Phase 1 Patients v1]	1	23 February 2016
Participant consent form [Phase 2 consent form]	1	23 February 2016
Participant consent form [Consent form phase 1]	1.1	27 April 2016
Participant consent form [Consent form phase 1 tracked changes]	1.1	27 April 2016
Participant information sheet (PIS) [Participant information sheet phase 1 clinician]	1.1	15 May 2016
Participant information sheet (PIS) [Lay summary phase 1 patient v1.1]	1.1	15 May 2016
Participant information sheet (PIS) [Participant information sheet phase 2 v2.1]	2.1	27 April 2016
Participant information sheet (PIS) [Lay summary phase 1 clinician v1.1]	1.1	27 April 2016
Participant information sheet (PIS) [Lay summary phase 2]	2.1	13 May 2016
Participant information sheet (PIS) [Participant information sheet phase 1 patient]	1.1	27 April 2016
Participant information sheet (PIS) [Participant information sheet phase 1 clinician v1.1 tracked changes]	1.1	15 May 2016
Participant information sheet (PIS) [Lay summary phase 1 patient 1.1 tracked changes]	1.1	15 May 2016
Participant information sheet (PIS) [Participant information sheet phase 2 v2.1 tracked changes]	2.1	27 April 2016
Participant information sheet (PIS) [Lay summary phase 1 clinician tracked changes]	1.1	27 April 2016
Participant information sheet (PIS) [Lay summary phase 2 tracked changes]	2.1	13 May 2016
Participant information sheet (PIS) [Participant information sheet phase 1 patients 1.1]	1.1	27 April 2016
REC Application Form [REC_Form_05042016]		05 April 2016
Referee's report or other scientific critique report [Feedback on project from UEA]	1	27 July 2015
Research protocol or project proposal [Research Protocol]	1	23 February 2016
Summary CV for Chief Investigator (CI) [Sophie Ames CV]	1	22 February 2016
Summary CV for supervisor (student research) [Sian Coker CV]	1	16 February 2016
Validated questionnaire [Diabetes self management questionnaire]	1	23 February 2016

Validated questionnaire [New general self efficacy questionnaire]	1	23 February 2016
Validated questionnaire [Diabetes empowerment scale]	1	23 February 2016
Validated questionnaire [PHQ-9]	1	23 February 2016

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website:
<http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance>

We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at <http://www.hra.nhs.uk/hra-training/>

16/SW/0121	Please quote this number on all correspondence
------------	--

With the Committee's best wishes for the success of this project.

Yours sincerely

pp. *L Roberts*

Canon Ian Ainsworth-Smith
Chair

Email: nrescommittee.southwest-cornwall-plymouth@nhs.net

Copy to: *Ms Yvonne Kirkham*
Ms Lisa Chalkley, NHS

Appendix C

Consent to contact form

**CONSENT TO CONTACT FORM (phase 1: patient v1 23.02.2016)**

Title of Project: A study of people with type 1 diabetes: Understanding insulin omission

Name of Researcher: Sophie Ames

Please initial box

1. I consent for my details to be passed on to the researcher, so that they can contact me to discuss the study.

☐

2. I would like to be contacted by PHONE/EMAIL/POST (please circle)

3. Please write the details for the method of contact you would prefer (e.g. phone number or email address or home address).

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~~~~~

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\_\_\_\_\_  
Name of Participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Name of Person  
taking consent

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

## Appendix D

### Consent Form



#### CONSENT FORM v1.1 27.04.2016

Title of Project: A study of people with type 1 diabetes: Understanding insulin omission

Name of Researcher: Sophie Ames

Please initial box

1. I confirm that I have read the information sheet dated..... (version.....) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, or refuse to answer any question I do not wish to, without giving any reason, without my medical care or legal rights being affected. ☐
3. I understand that my responses may be used to help develop a questionnaire about insulin. ☐
4. I agree to take part in the above study. ☐
5. I would you like to be contacted with a report of the results of the study?  
If yes, please provide an email address

YES/NO (please circle)

.....

\_\_\_\_\_  
Name of Participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Name of Person  
taking consent

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

Appendix E  
Online Consent Form



Diabetes survey

Consent form

**A study of adults with type 1 diabetes: investigating diabetes self-management and insulin omission.**

Researcher: Sophie Ames (Trainee Clinical Psychologist)

Supervised by: Dr Sian Coker

Doctoral Programme in Clinical Psychology,

School of Medicine and Health Sciences,

University of East Anglia

Edit

**\* 1. I confirm that I have read the information sheet for the above study. I have had the opportunity to consider the information.**

☐ Yes

☐ No

**\* 2. I understand that my participation is voluntary. I can withdraw, or save and come back to the survey at any time, without giving a reason.**

☐ Yes

☐ No

**\* 3. I understand that all data collected will remain confidential and that this will be stored securely and destroyed at the end of the study.**

**\* 4. I agree to parts of my responses being quoted in reports of the research on the basis that any identifying details are removed.**

☐ Yes

☐ No

**\* 5. I agree to take part in this study.**

☐ Yes

☐ No

## Appendix F

## Participant Information Sheet

Participant information sheet: Phase 1: patient (version: 1.1 date: 27.04.2016)

**Participant Information Sheet****A study of adults with type 1 diabetes: investigating insulin omission**

Researcher: Sophie Ames (Trainee Clinical Psychologist)

Supervised by: Dr Sian Coker

Doctoral Programme in Clinical Psychology,  
School of Medicine and Health Sciences,

University of East Anglia

**Invitation and brief summary**

We would like to invite you to take part in a research study conducted by The University of East Anglia and Cambridgeshire and Peterborough NHS Foundation Trust. The purpose of the study is to understand in depth why some people find managing their insulin medication for diabetes difficult. We are making a questionnaire to give to people to have diabetes, about insulin, and would like your help in creating this. You could take part by meeting the researcher at one of your

local diabetes clinics, or you could take part over email. Before you decide if you would like to take part, we will tell you why the research is being done and what it will involve for you. You will then be able to decide if you are interested in taking part in the study. Please get in touch if anything is not clear to you or you would like more information.

### **What is the purpose of the study?**

The overall purpose of the study is to understand in depth some of the reasons that people find managing their insulin medication difficult. This will involve developing a questionnaire that will ask questions about insulin in patients with type 1 diabetes. The research is being conducted as part of a Doctorate in Clinical Psychology at the University of East Anglia. This kind of research can help services understand some of the needs of people with diabetes, and to develop interventions to help.

### **Why have I been asked to take part?**

We are interested in the views of people with experience of type 1 diabetes. This could be people that have type 1 diabetes themselves, or care for someone that does.

### **What will the study involve?**

After looking through the information and agreeing for the researcher to contact you, the researcher will get in touch to ask if you would like to meet in person, or take part over email. If in person, this will probably be at your local diabetes clinics. If email, the researcher will email you on the address that you provided. You will see a copy of a questionnaire about insulin. We are interested in what you think of the questions, and any suggestions for different questions, wording, or format. There are no right or wrong answers, and you are free to decline to comment on anything that you do not wish to. It will take no more than 30 minutes.

### **Will my information be kept confidential?**

All personal information will be kept confidential. The data from the discussion will be kept securely at The University of East Anglia. It will be destroyed 10 years after the research has finished. You do not need to share any sensitive information. You will be given information about where to access support for diabetes. You will be given information about where to access support about issues relating to managing diabetes.

### **What are the possible disadvantages / benefits of taking part?**

It is possible that the topics of difficulties with managing diabetes will be upsetting for some people. An information sheet will be provided with where you can access support. There will be no direct benefits to you for taking part in this study. However, your contributions will provide the researcher with valuable feedback to develop the questionnaire. This information is likely to improve the questionnaire, which may help improve the care of people with diabetes in the future.

### **What if there is a problem?**

A list of contact details for services and organisations who may be able to support you will be provided in case the questions raise any issues that you would like to discuss further. You will also be able to contact myself or my research supervisor if you have any concerns about the study (details below). You are free to stop commenting on the questionnaire or withdraw at any point, without giving a reason, until you have sent the replies back by email.

### **What will happen to the results of the research study?**

The results of this study may be published in scientific journals and at medical and

psychological academic conferences. You will not be identified in any report or publication.

### **Who has reviewed the study?**

This study has been checked by the University of East Anglia and the South-West Cornwall and Plymouth Research Ethics Committee to protect your safety, rights, well-being and dignity.

### **Any further queries?**

If you have a concern or complaint about any aspect of the study, you may contact me in the first instance. Alternatively, you could contact my research supervisor, Dr. Sian Coker (see contact details below) If you remain unhappy and wish to complain formally, you can contact Professor Ken Laidlaw, (Director of UEA Clinical Psychology Course, 01603 593076)

### **Contact Details:**

#### **Sophie Ames**

Doctoral Programme in Clinical Psychology,  
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## Appendix G

### Participant information sheet

Participant information sheet: Phase 1: Clinicians (version 1.1 15.05.2016)



### **Participant Information Sheet**

#### **A study of adults with type 1 diabetes: investigating insulin omission**

Researcher: Sophie Ames (Trainee Clinical Psychologist)

Supervised by: Dr Sian Coker

Doctoral Programme in Clinical Psychology,

School of Medicine and Health Sciences,

University of East Anglia

### **Invitation and brief summary**

We would like to invite you to take part in a research study conducted by The University of East Anglia and Cambridgeshire and Peterborough NHS Foundation Trust. The study is investigating how often, when, and why patients with type 1 diabetes do not take insulin that they need. It will involve meeting with the researcher to discuss a questionnaire that is being developed. Before you decide if



you would like to take part, we will tell you why the research is being done and what it will involve for you. You will then be able to decide if you are interested in taking part in the study. Please get in touch if anything is not clear to you or you would like more information.

### **What is the purpose of the study?**

The overall purpose of the study is to understand in depth some of the reasons that people find managing their insulin medication difficult. This will involve developing a questionnaire that will be able to detect, measure, and identify some of the reasons for insulin omission in patients with type 1 diabetes. The research is being conducted as part of a Doctorate in Clinical Psychology at the University of East Anglia. This kind of research can help services understand some of the difficulties and needs of people with diabetes, and to develop interventions so that these needs can be met.

### **Why have I been asked to take part?**

We are interested in the views of clinicians who work with people with type 1 diabetes to help us to develop the questionnaire.

### **What will the study involve?**

The study will involve you attending a small discussion with the researcher and other clinicians, or meeting with the researcher individually, depending on availability. The questionnaire as it stands will be presented, and you will be asked for your opinion on the range, form and content of the questions. There are no right or wrong answers, and you are free to decline to answer any question you do not feel happy with. The group will last a maximum of one hour, and will be held on NHS premises in or around Norwich.

**Will my information be kept confidential?**

The data from the discussion will be kept securely at The University of East Anglia. It will be destroyed 10 years after the research has finished. Personal disclosures of a sensitive nature will not be necessary. You will be given information about where to access support about issues relating to managing diabetes.

**What are the possible disadvantages / benefits of taking part?**

It is possible that the topics discussed such as patients engaging in behaviour which puts them at risk will be distressing. An information sheet will be provided with where you can access support. There will be no direct benefits to you for taking part in this study. However, your contributions will provide the researcher with more valuable feedback to develop the questionnaire. This information is likely to improve the questionnaire, which may help improve the care of people with diabetes in the future.

**What if there is a problem?**

A list of contact details for services and organisations who may be able to support you will be provided in case the questions raise any issues that you would like to discuss further. You will also be able to contact myself or my research supervisor if you have any concerns about the study (details below). You are free to leave the discussion at any point.

**What will happen to the results of the research study?**

The results of this study may be published in scientific journals and at conferences. You will not be identified in any report.

**Who has reviewed the study?**

This study has been checked by the University of East Anglia and the South-West

Cornwall and Plymouth Research Ethics Committee to protect your safety, rights, well-being and dignity.

**Any further queries?**

If you have a concern or complaint about any aspect of the study, you may contact me in the first instance. Alternatively, you could contact my research supervisor, Dr. Sian Coker (see contact details below) If you remain unhappy and wish to complain formally, you can contact Professor Ken Laidlaw, (Director of UEA Clinical Psychology Course, 01603 593076)

**Contact Details:**

**Sophie Ames**

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NR4 7TJ

## Appendix H

### Participant Information Sheet

Participant information sheet: Phase 2 (version 2.1, date 27.04.2016)



### Participant Information Sheet

#### **A study of adults with type 1 diabetes: investigating insulin omission**

Researcher: Sophie Ames (Trainee Clinical Psychologist)

Supervised by: Dr Sian Coker

Doctoral Programme in Clinical Psychology,

School of Medicine and Health Sciences,

University of East Anglia

### **Invitation and brief summary**

We would like to invite you to take part in a research study conducted by The University of East Anglia and Cambridgeshire and Peterborough NHS Foundation Trust. The study will investigate people's experiences of managing their type 1 diabetes. Before you decide if you would like to take part, we will tell you why the research is being done and what it will involve for you. You will then be able to

decide if you are interested in taking part in the study. If you would like more time to think about it, you can come back to this web page at a later date. Please get in touch if anything is not clear to you or you would like more information.

### **What is the purpose of the study?**

The purpose of the study is to understand in depth some of the reasons that people find managing their insulin medication difficult. The research is being conducted as part of a Doctorate in Clinical Psychology at the University of East Anglia. This kind of research can help services understand some of the difficulties and needs of people with diabetes, and to develop interventions so that these needs can be met.

### **Why have I been asked to take part?**

We are interested in the views of adults between 18-65 who have had type 1 diabetes for over 1 year, and live within the European Union (EU).

### **What will the study involve?**

The study will involve you completing a series of questionnaires online which can be done at home. The questionnaires have all been approved by an ethics committee. You will be asked about the things that you do to manage your diabetes, some questions about insulin, your experiences, your mood, and how able you feel to manage these things. Some of the questions will have space for you to write about these things in detail. The questionnaires should take around 30 minutes to complete. There are no right or wrong answers, and you are free to decline to answer any question you do not feel happy with.

### **Will my information be kept confidential?**

All personal information will be kept confidential. Parts of your responses may be quoted in reports of the research, but all identifying details will be removed. We will not ask for your name or for any contact details. Your GP and any other health professionals will not be informed that you are taking part in the study. It will not be possible for the researchers to contact them. The data from the questionnaires will be kept securely at The University of East Anglia. It will be destroyed 10 years after the research has finished. You are able to withdraw at any point up until you complete the survey without giving a reason.

### **What are the possible disadvantages / benefits of taking part?**

You will be asked to complete a series of questionnaires which can be done at home. It is possible that the topics discussed such as mood and any difficulties with managing your diabetes will be difficult for some people. An information sheet will be provided with where you can access support. There will be no direct benefits to you for taking part in this study. However, the answers that you give will provide the researchers with more information about diabetes self-management. This information may help improve the care of people with diabetes in the future.

### **What if there is a problem?**

A list of contact details for services and organisations who may be able to support you will be provided in case the questions raise any issues that you would like to discuss further. You will also be able to contact myself or my research supervisor if you have any concerns about the study (details below). You are free to stop completing the survey at any point.

### **What will happen to the results of the research study?**

The results of this study may be published in scientific journals and at medical and psychological academic conferences. You will not be identified in any report or

publication.

### **Who has reviewed the study?**

This study has been checked by the University of East Anglia and the South-West Cornwall and Plymouth Research Ethics Committee to protect your safety, rights, well-being and dignity.

### **Any further queries?**

If you have a concern or complaint about any aspect of the study, you may contact me in the first instance. Alternatively, you could contact my research supervisor, Dr. Sian Coker (see contact details below) If you remain unhappy and wish to complain formally, you can contact Professor Ken Laidlaw, (Director of UEA Clinical Psychology Course, 01603 593076)

### **Contact Details:**

#### **Sophie Ames**

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Norwich Research Park  
NORWICH  
NR4 7TJ

## Appendix I

### Final Page of Survey

#### Thank you for taking part in this survey!

If you have been affected by any of the questions asked in the study, you may be able to receive advice and/or support from the following:

NHS Choices: Living with type 1 diabetes.

Offering advice and information about managing type 1 diabetes.

Web page: <http://www.nhs.uk/Conditions/Diabetes-type1/Pages/living-with.aspx>

Diabetes UK: Talk to Someone.

Offering a UK helpline, local support groups, online communities and peer support.

Web page: [https://www.diabetes.org.uk/How\\_we\\_help/Talk-to-someone/](https://www.diabetes.org.uk/How_we_help/Talk-to-someone/)

UK Helpline: 0345 123 2399, Monday–Friday, 9am–7pm.

Edit

Diabetes.co.uk.

Providing support forums, advice and information

Web page: <http://www.diabetes.co.uk/diabetes-support-forums.html>

Joslin Diabetes Centre

Offering information about eating disorders and diabetes

Web page: [http://www.joslin.org/info/Eating\\_Disorders\\_Diabulimia\\_in\\_Type\\_1\\_Diabetes.html](http://www.joslin.org/info/Eating_Disorders_Diabulimia_in_Type_1_Diabetes.html)

If you have been affected by any of the issues in the survey and would like to contact the researcher about this, please email [s.ames@uea.ac.uk](mailto:s.ames@uea.ac.uk). Your responses will remain confidential but may not longer be anonymous.

If you feel that you require extra support, please contact your GP to discuss this.

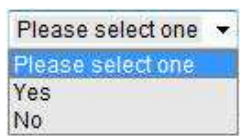


## Appendix J

## Insulin Questionnaire Version 1

Insulin Questionnaire – unvalidated version 1 23.02.2016

1a) Do you ever skip (miss out) insulin doses that you know you should take?

A dropdown menu with a light blue header bar containing the text "Please select one" and a small downward arrow. The menu is open, showing a list of options: "Please select one" (highlighted in blue), "Yes", and "No".

If yes:

1b) On how many of the past 7 days did you skip an insulin dose that you knew you should take?

 .... days

1c) How many times in the past 7 days did you skip an insulin dose that you knew you should take?

 .... times

1d) On how many days in the past month (28 days) did you skip an insulin dose that you knew you should take?

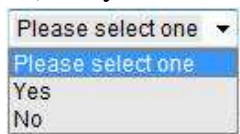
 .... Days

1e) How many times in the past month days did you skip an insulin dose that you knew you should take?

 .... times**1f) Please explain in your own words why you skipped an insulin dose that you knew you should take.**

Please type here.....

2a) Do you ever take less insulin than you know you should take?

A dropdown menu with a light blue header bar containing the text "Please select one" and a small downward arrow. The menu is open, showing a list of options: "Please select one" (highlighted in blue), "Yes", and "No".

If yes:

2b) On how many of the past 7 days did you take less insulin than you knew you should take?  days

2c) How many times in the past 7 days did you take less insulin than you knew you should take?  
 times

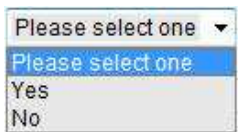
2d) On how many days in the last month did you take less insulin than you knew you should take?  
 days

2e) How many times in the past month did you take less insulin than you knew you should take?  
 times

**2f) Please explain in your own words why you took less insulin than you knew you should.**

Please type here.....

3a) Do you ever forget to take your insulin?



If yes:

3b) On how many of the last 7 days did you forget to take your insulin?  
 days

3c) How many times in the last 7 days did you forget to take your insulin?  
 times

3d) On how many days in the last month did you forget to take your insulin?  
 Days

3e) How many times in the last month did you forget to take your insulin?  
 times

**3f) Please explain in your own words why you forgot to take your insulin.**

Please type here.....

4a) Do you ever stop taking your insulin for a while?

**4b) Please explain in your own words why you stop taking insulin for a while.**

Please type here.....

**5) Does your mood effect how you take insulin? If Yes, how?**

Please type here.....

**6) Under what circumstances are you more likely to take insulin as you should?**

Please type here.....

**7) Under what circumstances are you less likely to take insulin as you should?**

Please type here.....



## Appendix K

## Insulin Questionnaire Version 2

**Diabetes survey**

## Insulin Questionnaire

Living with diabetes is hard work, practically, physically and psychologically.

Research tells us that many people miss insulin doses sometimes. This questionnaire is to help us understand why.

**21. What insulin regime are you on?**

- ☐ Long acting
- ☐ Short acting
- ☐ Both

**22. Do you ever skip (miss out) insulin doses that you know you should take?**

- ☐ Yes
- ☐ No

**23. If yes to Q22:**

**In the last 7 days, was this:**

- ☐ Less than 2 times
- ☐ 2-4 times
- ☐ 4-6 times
- ☐ 7 or more times

Were these at the same time of day?

---

**24. If yes to Q22:**

Could you explain in your own words why you skipped an insulin dose that you knew you should take?

**25. Do you ever take less or more insulin than you know you should take?**

- ☐ No
- ☐ Yes - less
- ☐ Yes - more
- ☐ Yes- both

**26. If yes to Q25:**

In the last 7 days, was this:

- ☐ Less than 2 times
- ☐ 2-4 times
- ☐ 4-6 times
- ☐ 7 or more times

Were these at the same time of day?

**27. If yes to Q25:**

Could you explain in your own words why you took less or more insulin than you knew you should?

**28. Is there a time of day when you would be likely to skip an insulin dose?**

**If yes: when?**

**29. Is there a particular dose of insulin that you are likely to skip?**

**If yes, which one?**

**30. Is skipping insulin doses, or taking more or less insulin than you should, a problem for you?**

☐ Yes

☐ No

**Any comments?**

**31. Does your mood effect how you take insulin?**

☐ Yes

☐ No

**If yes, how?**

**32. Does taking insulin effect your mood?**

☐ Yes

☐ No

If yes, how?

33. What makes you less likely to take insulin as you should?

34. What makes you more likely to take insulin as you should?

35. What would motivate you to take your insulin as you should?

36. Would you, or do you, tell your diabetes team if you are missing insulin doses?

- ☐ Yes
- ☐ No

37. We are really interested in your feedback on the Insulin Questionnaire (questions 21-36). Do you have any comments about this?

38. Where did you hear about this survey?

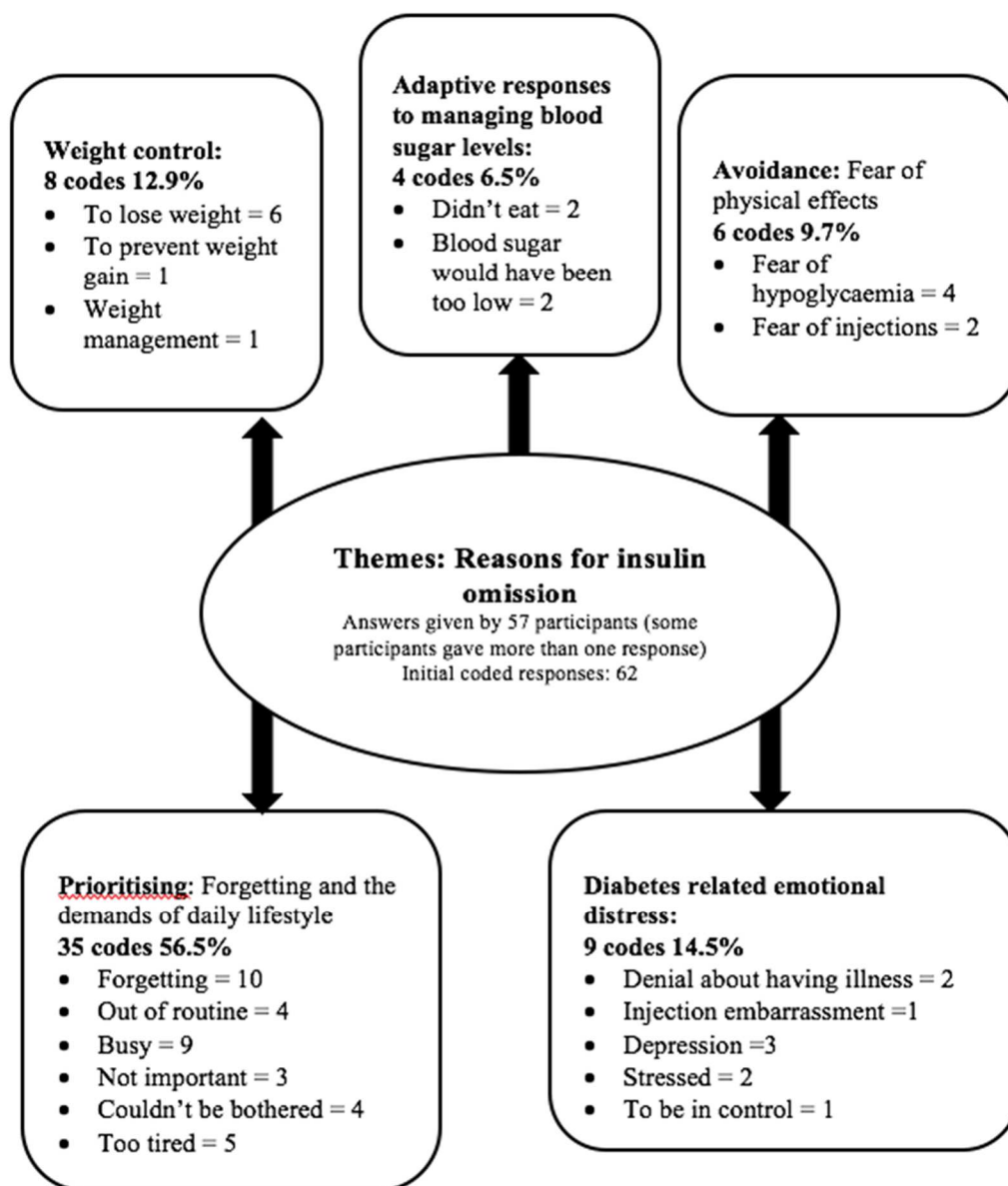
- ☐ Online diabetes support group
- ☐ NHS diabetes service
- ☒ Friends or family
- ☐ Other (please specify)



## Appendix L

## Thematic Map:

## Reasons for Insulin Omission



## Appendix M

## Diabetes self management questionnaire

**Table 1****Diabetes Self-Management Questionnaire (DSMQ)**

The following statements describe self-care activities related to your diabetes. Thinking about your self-care over the last 8 weeks, please specify the extent to which each statement applies to you.

|                                                                                                                                                                                                                          | Applies to me very much    | Applies to me to a considerable degree | Applies to me to some degree | Does not apply to me       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------|------------------------------|----------------------------|
| 1. I check my blood sugar levels with care and attention.<br><input type="checkbox"/> Blood sugar measurement is not required as a part of my treatment.                                                                 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 2. The food I choose to eat makes it easy to achieve optimal blood sugar levels.                                                                                                                                         | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 3. I keep all doctors' appointments recommended for my diabetes treatment.                                                                                                                                               | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 4. I take my diabetes medication (e. g. insulin, tablets) as prescribed.<br><input type="checkbox"/> Diabetes medication / insulin is not required as a part of my treatment.                                            | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 5. Occasionally I eat lots of sweets or other foods rich in carbohydrates.                                                                                                                                               | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 6. I record my blood sugar levels regularly (or analyse the value chart with my blood glucose meter).<br><input type="checkbox"/> Blood sugar measurement is not required as a part of my treatment.                     | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 7. I tend to avoid diabetes-related doctors' appointments.                                                                                                                                                               | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 8. I do regular physical activity to achieve optimal blood sugar levels.                                                                                                                                                 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 9. I strictly follow the dietary recommendations given by my doctor or diabetes specialist.                                                                                                                              | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 10. I do not check my blood sugar levels frequently enough as would be required for achieving good blood glucose control.<br><input type="checkbox"/> Blood sugar measurement is not required as a part of my treatment. | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 11. I avoid physical activity, although it would improve my diabetes.                                                                                                                                                    | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 12. I tend to forget to take or skip my diabetes medication (e. g. insulin, tablets).<br><input type="checkbox"/> Diabetes medication / insulin is not required as a part of my treatment.                               | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 13. Sometimes I have real 'food binges' (not triggered by hypoglycaemia).                                                                                                                                                | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 14. Regarding my diabetes care, I should see my medical practitioner(s) more often.                                                                                                                                      | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 15. I tend to skip planned physical activity.                                                                                                                                                                            | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |
| 16. My diabetes self-care is poor.                                                                                                                                                                                       | <input type="checkbox"/> 3 | <input type="checkbox"/> 2             | <input type="checkbox"/> 1   | <input type="checkbox"/> 0 |

## Appendix N

## New general self-efficacy questionnaire

|                            |                                                                             |
|----------------------------|-----------------------------------------------------------------------------|
| 1                          | 1. I will be able to achieve most of the goals that I have set for myself.  |
| 2                          | 2. When facing difficult tasks, I am certain that I will accomplish them.   |
| 3                          | 3. In general, I think that I can obtain outcomes that are important to me. |
| 4                          | 4. I believe I can succeed at most any endeavor to which I set my mind.     |
| 5                          | 5. I will be able to successfully overcome many challenges.                 |
| 6                          | 6. I am confident that I can perform effectively on many different tasks.   |
| 7                          | 7. Compared to other people, I can do most tasks very well.                 |
| 8                          | 8. Even when things are tough, I can perform quite well.                    |
| <b>Response<br/>Format</b> | 1 = Not at all true 2 = Hardly true 3 = Moderately true 4 = Exactly true    |

## Appendix O

## Diabetes specific self efficacy questionnaire – short form

## University of Michigan Diabetes Research and Training Center

## Diabetes Empowerment Scale-Short Form (DES-SF)

The 8 items below constitute the DES-SF. The scale is scored by averaging the scores of all completed items (Strongly Disagree = 1, Strongly Agree = 5)

des

Check the box that gives the best answer for you.

## In general, I believe that I:

- |                                                                                                 |                                               |                                               |                                     |                                            |                                            |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------|-------------------------------------|--------------------------------------------|--------------------------------------------|
| 1. ...know what part(s) of taking care of my diabetes that I am <b>dissatisfied</b> with.       | <input type="checkbox"/><br>Strongly Disagree | <input type="checkbox"/><br>Somewhat Disagree | <input type="checkbox"/><br>Neutral | <input type="checkbox"/><br>Somewhat Agree | <input type="checkbox"/><br>Strongly Agree |
| 2. ...am able to turn my diabetes goals into a workable plan.                                   | <input type="checkbox"/><br>Strongly Disagree | <input type="checkbox"/><br>Somewhat Disagree | <input type="checkbox"/><br>Neutral | <input type="checkbox"/><br>Somewhat Agree | <input type="checkbox"/><br>Strongly Agree |
| 3. ...can try out different ways of overcoming barriers to my diabetes goals.                   | <input type="checkbox"/><br>Strongly Disagree | <input type="checkbox"/><br>Somewhat Disagree | <input type="checkbox"/><br>Neutral | <input type="checkbox"/><br>Somewhat Agree | <input type="checkbox"/><br>Strongly Agree |
| 4. ...can find ways to feel better about <b>having</b> diabetes.                                | <input type="checkbox"/><br>Strongly Disagree | <input type="checkbox"/><br>Somewhat Disagree | <input type="checkbox"/><br>Neutral | <input type="checkbox"/><br>Somewhat Agree | <input type="checkbox"/><br>Strongly Agree |
| 5. ...know the <b>positive</b> ways I cope with diabetes-related stress.                        | <input type="checkbox"/><br>Strongly Disagree | <input type="checkbox"/><br>Somewhat Disagree | <input type="checkbox"/><br>Neutral | <input type="checkbox"/><br>Somewhat Agree | <input type="checkbox"/><br>Strongly Agree |
| 6. ...can ask for support for having and caring for my diabetes when I need it.                 | <input type="checkbox"/><br>Strongly Disagree | <input type="checkbox"/><br>Somewhat Disagree | <input type="checkbox"/><br>Neutral | <input type="checkbox"/><br>Somewhat Agree | <input type="checkbox"/><br>Strongly Agree |
| 7. ...know what helps me stay motivated to care for my diabetes.                                | <input type="checkbox"/><br>Strongly Disagree | <input type="checkbox"/><br>Somewhat Disagree | <input type="checkbox"/><br>Neutral | <input type="checkbox"/><br>Somewhat Agree | <input type="checkbox"/><br>Strongly Agree |
| 8. ...know enough about myself as a person to make diabetes care choices that are right for me. | <input type="checkbox"/><br>Strongly Disagree | <input type="checkbox"/><br>Somewhat Disagree | <input type="checkbox"/><br>Neutral | <input type="checkbox"/><br>Somewhat Agree | <input type="checkbox"/><br>Strongly Agree |

## Appendix P

## Patient health questionnaire version 9 (PHQ-9)

| PATIENT HEALTH QUESTIONNAIRE-9<br>(PHQ-9)                                                                                                                                   |            |              |                         |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------|-------------------------|------------------|
| Over the <u>last 2 weeks</u> , how often have you been bothered by any of the following problems?<br>(Use "✓" to indicate your answer)                                      |            |              |                         |                  |
|                                                                                                                                                                             | Not at all | Several days | More than half the days | Nearly every day |
| 1. Little interest or pleasure in doing things                                                                                                                              | 0          | 1            | 2                       | 3                |
| 2. Feeling down, depressed, or hopeless                                                                                                                                     | 0          | 1            | 2                       | 3                |
| 3. Trouble falling or staying asleep, or sleeping too much                                                                                                                  | 0          | 1            | 2                       | 3                |
| 4. Feeling tired or having little energy                                                                                                                                    | 0          | 1            | 2                       | 3                |
| 5. Poor appetite or overeating                                                                                                                                              | 0          | 1            | 2                       | 3                |
| 6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down                                                                          | 0          | 1            | 2                       | 3                |
| 7. Trouble concentrating on things, such as reading the newspaper or watching television                                                                                    | 0          | 1            | 2                       | 3                |
| 8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual | 0          | 1            | 2                       | 3                |
| 9. Thoughts that you would be better off dead or of hurting yourself in some way                                                                                            | 0          | 1            | 2                       | 3                |

FOR OFFICE CODING 0 +      +      +       
**\*Total Score:**     

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If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

| Not difficult at all     | Somewhat difficult       | Very difficult           | Extremely difficult      |
|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |